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# Ambulance Reliability Control

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AMBULANCE RELIABILITY CONTROL

A Major Qualifying Project Report:

submitted to the Faculty

of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

by

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Approved:

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2. Reliability
3. Transportation

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**Professor Mustapha S. Fofana, Major Advisor**

This report represents the work of one or more WPI undergraduate students submitted to the faculty as evidence of completion of a degree requirement. WPI routinely publishes these reports on its web site without editorial or peer review.

## ***Abstract***

Medical ambulances have been used for centuries to carry ailing patients to hospitals, and in more recent years to provide care along the way. The current style of medical ambulance, however, has remained relatively unchanged through recent history despite significant technological advances in mechanization, computer technology, material processing, and manufacturing. The end goal of this project is the incorporation of these advancements into the ambulance design.

In this first phase of the project, the current ambulance design and governing regulations were studied thoroughly in an effort to gain an overall understanding of the current ambulance. As a result of this study as well as EMT input, the features of the patient compartment that hinder EMT performance and compromise passenger safety were identified and addressed. These areas were then redesigned to improve the functionality, reliability and safety of the ambulance.

Important aspects of the new design are material selection, innovative mechanical designs, optimized ergonomics, and the incorporation of advanced technologies. In addition to improving the layout of the patient compartment, this project lays the groundwork for future project teams to address areas outside of mechanical design. Communication and data transfer, as well as the development of electronic sensors will be important additions to the ambulance design.

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## **1. Introduction**

One of the most important functions of any civilized society is to provide medical assistance to those in need. This basic human right of medical treatment has been performed with increasing efficiency over the course of many hundreds of years, and though the basic idea is the same – to heal the sick – the methods by which the sick are healed have been steadily and significantly improving.

In the early medical profession it was common practice for the physician to visit the home of the patient to provide care. This system worked well for the treatment of routine sickness and other low priority maladies, though individuals who suffered traumatic accidents or sudden afflictions like heart attacks or strokes often did not survive due to the lack of timely medical treatment.

As populations increased, the practice of home visits from physicians became less practical, and specific medical centers were created where patients could be treated systematically. With this change in the structure of the medical system, however, a new problem was created; the patient must be transported to the location where care is provided. This excluded individuals who did not have a means of transportation from receiving adequate emergency medical care, and for extremely ill individuals or those who had suffered a traumatic accident, a trip to the hospital by conventional means may have proven inadequate to save their life. Over the course of history, ambulance services were gradually developed to transport patients to the hospital while simultaneously administering medical treatment.

Significant advances have been made in the medical field over the past few decades, and these advances have drastically increased a patient's odds of surviving a

severe illness or traumatic injury once they have been admitted to a hospital. In many cases, however, patients are injured or become ill far away from the nearest hospital, and therefore must wait for a significant period of time before they are admitted to the hospital where they can benefit from these technological advances. Because time to treatment is so often crucial in determining the survival of a patient, reduction of this time is one of the most important goals in the further advancement of modern medicine.

The ambulance as it exists today is effective in decreasing the time to treatment for a patient. EMTs and paramedics are able to provide first aid to sick and injured individuals within minutes of arriving on the scene, and these first aid measures are invaluable in supporting the life of the patient en route to the hospital. This process, however, is far from perfect. Modern ambulances are essentially box-trucks packed with the necessary supplies to support the life of an ailing individual, though there have been very few design changes in the areas of efficiency and ergonomics, safety, contamination control, weight reduction, and advanced patient care capabilities.

Each of these categories is important to the overall performance of the first response process. The cabin layout of current ambulances is lacking in its ability to allow first responders to move freely around the patient. Ambulances are so heavy that maneuverability and mobility are hindered. In the event that a traffic accident occurs, EMTs and paramedics are at a high risk of serious injury due to the design of the ambulance interior. Ambulance cleanup and decontamination is a lengthy process which can prevent an ambulance from responding to calls for hours at a time.

It is for these reasons that a redesign of the modern ambulance would be beneficial and prudent. Ambulance technology has remained largely unchanged for

decades while major advancements have been made in patient care at the hospital. Modern advances in synthetic materials, safety technology, miniature electronics, and computer aided design software are all tools that can be used to create a new generation of ambulances that will greatly improve the first response experience for both the patient and the caregiver.

The remaining part of the document is organized as follows. Chapter Two contains the background information about ambulance types, design, manufacturing and their applications to specific situations. In Chapter Three, the areas of focus are identified and discussed, which will serve as an outline for future design work. Chapter Four concludes the first section of the project.

## **2. Background Research**

### **2.1 Types of Ambulances**

There are three main types of ambulances; I, II and III. In addition to these three main types, there are two additional types; I AD and III AD, AD meaning “additional duty,” which means the vehicles are more fully equipped and can handle more work than the other three standard types. These ambulance types are all determined by several factors, including how the rear box and front cab are mated, size, payload allowances and content requirements.

Although there are five distinct types of ambulances, there are many elements that all types of ambulances have in common. These include the class and configuration for each ambulance type, permitted weight distributions of the vehicles when loaded, and several others. All of these specifications relate directly to the physical dimensions and properties of the ambulance, and all of these criteria must be met when designing an ambulance. Following is a list of specifications and definitions that all types of ambulances follow.

#### **Class:**

- **Class 1** - Two rear wheel driven (4x2)
- **Class 2** - Four wheel driven (4x4)

#### **Configuration:**

- **Configuration A** - Elevating cot and squad bench for ALS
  - One primary patient on a wheeled elevating cot and a secondary patient lying on a stretcher on the squad bench, or one primary patient on a wheeled elevating cot and three secondary patients seated on the squad bench

- **Configuration B** - Elevating cot and squad bench for BLS
  - One primary patient on a wheel elevating cot and a secondary patient lying on a stretcher on the squad bench

**Minimum Ground Clearance** - Minimum distance of 8" between ground and undercarriage of vehicle when loaded to GVWR (Gross Vehicle Weight Rating)

**Floor Height** - Distance between the ground to the floor of vehicle (interior) must be a maximum of 34" when loaded to GVWR

**Side to Side Weight Distribution** - The weight difference between the right and left side of a given axle must be within 5% when on a level surface

**Front to Back Weight Distribution** - When loaded to the GVWR, and within the GAWR (Gross Axle Weight Rating) for each axle, the front to rear weight distribution shall have not less than 20% of the total weight on the front axle, and not less than 50% nor more than 80% on the rear axle

**Angle of Approach** - The vehicle must be able to approach an incline at a minimum of 20 degrees without the vehicle body making contact with the ground

**Ramp Breakover Angle** - The vehicle must be able to drive over a ridge with a minimum included angle of 10 degrees without the vehicle undercarriage making contact with the ground

**Departure Angle** - The vehicle must be able to depart from an incline at a minimum of 10 degrees without the vehicle body making contact with the ground

With all these specifications shared by all five types of ambulances, there are additional specifications that are used to distinguish between the different types. These include how the rear box and front cab are mated, size, vehicle weight rating, payload

requirements and content requirements. Following is a brief section for each type of ambulance, listing and describing the requirements and specifications that define each respective ambulance type.

### **2.1.1 Type I**

Type I ambulances have a modular, or detachable, body built on a truck chassis. The truck cab is connected to the body through a small window, but the occupants of the cab must go outside the vehicle to enter the ambulance body. These vehicles can be either single or dual rear wheel, although most dual wheel type I ambulances fall into the Type I AD classification. Below is a list of specifications for the size and weight requirements for the Type I ambulance:

- **Average GVWR** - 10,001lb – 14,000lb
- **Average Curb Weight** - 5,000lb – 5,600lb
- **Average Size:**
  - **Height:**
    - Minimum 60” between floor and ceiling (interior)
    - Maximum 110” total height at curb weight (exterior, excluding antennas)
  - **Width:**
    - Maximum 96” (exterior; if dual rear wheels)
    - Between 79” and 84” (exterior, if single rear wheels)
  - **Length:**
    - Minimum 122” (interior)



- At least 25” of unobstructed space between back of EMSP seat and nearest edge of cot
- At least 10” of unobstructed space between rear loading doors and nearest edge of cot
- Maximum total exterior length of 264”
  - **Volume** - Minimum of 325 cubic feet
- **Required Payload** - 1,750lb
- **Required Contents** - (See Required Equipment Lists for BLS and ALS for Type II emergency vehicles in appendix)

### 2.1.2 Type I AD

Like Type I ambulances, Type I AD (Additional Duty) ambulances have a modular, or detachable, body built on a truck chassis. The truck cab is connected to the body through a small window, but the occupants of the cab must go outside the vehicle to enter the ambulance body. Type I AD ambulances are similar to a Type I ambulance as far as the body design, but with increased GVWR, storage and payload, and in most cases, utilize dual rear wheels. Below is a list of specifications for the size and weight requirements for the Type I AD ambulance:

- **Average GVWR** - 14,001lb and higher
- **Average Curb Weight** - 5,000lb – 5,600lb
- **Average Size:**
  - **Height:**
    - Minimum 60” between floor and ceiling (interior)

- Maximum 110” total height at curb weight (exterior, excluding antennas)
- **Width:**
  - Maximum 96” (exterior; if dual rear wheels)
  - Between 79” and 84” (exterior, if single rear wheels)
- **Length:**
  - Minimum 122” (interior)
  - At least 25” of unobstructed space between back of EMSP seat and nearest edge of cot
  - At least 10” of unobstructed space between rear loading doors and nearest edge of cot
  - Maximum total exterior length of 264”
- **Volume** - Minimum of 325 cubic feet
- **Required Payload** - 2,250lb
- **Required Contents** - (See Required Equipment Lists for BLS and ALS for Type II emergency vehicles in appendix)



**Figure 1: Type I Ambulance**

### 2.1.3 Type II

Type II ambulances use a van with a raised roof. Because of the van construction, the occupants of the cab can easily enter the body from the inside, although the interior space is limited. Type II ambulances are of the lightest duty, provided the least amount of work area and required supplies. Below is a list of specifications for the size and weight requirements for the Type II ambulance:

- **Average GVWR** - 9,201lb – 10,000lb
- **Average Curb Weight** - 5,000lb
- **Average Size:**
  - **Height:**
    - Minimum 60” between floor and ceiling (interior)
    - Maximum 110” total height at curb weight (exterior, excluding antennas)
  - **Width:**
    - Maximum 96” (exterior; if dual rear wheels)
    - Between 79” and 84” (exterior, if single rear wheels)
  - **Length:**
    - Minimum 122” (interior)
    - At least 25” of unobstructed space between back of EMSP seat and nearest edge of cot
    - At least 10” of unobstructed space between rear loading doors and nearest edge of cot
    - Maximum total exterior length of 264”

- **Volume** - Minimum of 275 cubic feet
- **Required Payload** - 1,500lb
- **Required Contents** - (See Required Equipment Lists for BLS and ALS for Type II emergency vehicles in appendix)



**Figure 2: Type II Ambulance**

### **2.1.4 Type III**

Type III ambulances have a modular body built on a cut-away van chassis. This design combines the capacity of the larger modular body with the walk-through accessibility of a van. Type III ambulances most often contain the greatest amount of work area and supplies, and utilize either single or dual rear wheels, although most often dual rear wheels are found on Type III AD ambulances. Below is a list of specifications for the size and weight requirements for the Type III ambulance:

- **Average GVWR** - 10,001lb – 14,000lb

- **Average Curb Weight** - 5,000lb – 5,600lb
- **Average Size:**
  - **Height:**
    - Minimum 60” between floor and ceiling (interior)
    - Maximum 110” total height at curb weight (exterior, excluding antennas)
  - **Width:**
    - Maximum 96” (exterior; if dual rear wheels)
    - Between 79” and 84” (exterior, if single rear wheels)
  - **Length:**
    - Minimum 122” (interior)
    - At least 25” of unobstructed space between back of EMSP seat and nearest edge of cot
    - At least 10” of unobstructed space between rear loading doors and nearest edge of cot
    - Maximum total exterior length of 264”
  - **Volume** - Minimum of 325 cubic feet
- **Required Payload** - 1,750lb
- **Required Contents** - (See Required Equipment Lists for BLS and ALS for Type II emergency vehicles in appendix)

### 2.1.5 Type III AD

Like Type III ambulances, Type III AD ambulances have a modular body built on a cut-away van chassis. This design combines the capacity of the larger modular body with the walk-through accessibility of a van. Type III AD ambulances are similar to a Type III ambulance as far as the body design, but with increased GVWR, storage and payload. Below is a list of specifications for the size and weight requirements for the Type III AD ambulance:

- **Average GVWR** - 14,000lb and higher
- **Average Curb Weight** - 5,000lb – 5,600lb
- **Average Size:**
  - **Height:**
    - Minimum 60” between floor and ceiling (interior)
    - Maximum 110” total height at curb weight (exterior, excluding antennas)
  - **Width:**
    - Maximum 96” (exterior; if dual rear wheels)
    - Between 79” and 84” (exterior, if single rear wheels)
  - **Length:**
    - Minimum 122” (interior)
    - At least 25” of unobstructed space between back of EMSP seat and nearest edge of cot
    - At least 10” of unobstructed space between rear loading doors and nearest edge of cot
    - Maximum total exterior length of 264”

- **Volume** - Minimum of 325 cubic feet
- **Required Payload** - 2,250lb
- **Required Contents** - (See Required Equipment Lists for BLS and ALS for Type II emergency vehicles in appendix)



**Figure 3: Type III Ambulance**

## **2.2 Generations of Ambulances**

Throughout the century, the design of the ambulance has been drastically transformed. From both a design and safety standpoint, modern ambulances are far superior and more efficient than their earlier, more primitive ancestors. Improvements in storage, comfort, accessibility and performance have steadily increased over the century, and will continue to occur well into the twenty-first century. Past ambulance models



make it possible to understand which elements will benefit the most from design improvements. The following sections give a brief overview of ambulances used by the military throughout the twentieth century from World War I through the Iraq War<sup>1</sup>. With these, the improvements and technological advances are apparent in each new generation of ambulance.

### **2.2.1 World War I**

During World War One, the American Red Cross introduced motorized battlefield ambulances to replace the horse drawn vehicles previously used for casualty transport. These motorized ambulances were extremely successful, and horse drawn models were quickly phased out of service. In civilian emergency care, dedicated ambulance services were frequently managed or dispatched by individual hospitals, though in some areas, telegraph and telephone services enabled police departments to handle dispatch duties.

The equipment carried by the ambulance was also changing. Traction splints were introduced during World War I, and were found to have a positive effect on the morbidity and mortality of patients with leg fractures. Two-way radios became available shortly after World War I, enabling for more efficient radio dispatch of ambulances in some areas. Shortly before World War II, a modern ambulance carried advanced medical equipment, was staffed by a physician, and was dispatched by radio. In many locations, however, ambulances were hearses - the only available vehicle that could carry a recumbent patient - and were thus frequently run by funeral homes.

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<sup>1</sup> See reference 20



**Figure 4: World War I Ambulance (ref. 20)**

### **2.2.2 World War II**

Civilian ambulance quality fell sharply during World War II in much of the world due to the increased demand for physicians by the armed services. In England, during the Battle of Britain, the need for ambulances was so great that vans were commandeered and pressed into service, often carrying several victims at once. Following the war, physicians would continue to ride ambulances in some countries, but not in others, and many other vehicles, including civilian and police cars were used to transport patients due to a lack of a dedicated resource.



**Figure 5: World War II Ambulance (ref. 20)**

### **2.2.3 Vietnam War**

During the Vietnam War, the use of ground ambulances by the United States Army was scarce, since the war was fought overseas in dense jungles with limited or no access roads for vehicles to travel on. Instead, most emergency medical transportation of wounded soldiers was operated by use of helicopter ambulances. These helicopters enabled greater access to wounded soldiers in the middle of these thick jungles, and provided faster transport to the nearest emergency medical station. For this reason, the ground ambulance was not significantly changed from the ambulances used during World War II, nearly thirty years earlier. Built on a similar truck chassis, the ambulances of the Vietnam War provided less than ideal conditions for transporting and administering emergency medical care to wounded soldiers<sup>2</sup>.

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<sup>2</sup> See reference 20



**Figure 6: Vietnam War Ambulance (ref. 20)**

#### **2.2.4 Iraq War**

Built around a standard military Humvee truck body, the ambulances used during the war in Iraq represent the most well equipped and safest generation of ambulances used for military purposes. Constructed to withstand the abuse of rough terrain, natural elements and weapon assault from enemy attacks, the modern military ground ambulance provides the safest mode of transport for wounded soldiers in Iraq. In addition to being the most safe and capable ambulance used by the military to date, it is also the most well equipped, providing much more efficient and abundant medical supplies and treatment capabilities than past models. The ambulances used by the military today are the best equipped and capable military ambulances used to date, and provide the greatest similarities to civilian ambulances as far as performance and efficiency.





**Figure 7: Iraq War Ambulance (ref. 20)**

### **2.3 Important Features and Components**

There are several features and components of the ambulance that play important roles in the overall performance and efficiency of the ambulance. These include storage, communication, lighting, climate control, oxygen storage and supply and the stretcher. The following sections will discuss, in detail, the descriptions and functions of each of these components and features, as well as provide federal specifications and guidelines to which they must comply to.

### **2.3.1 Storage**

The following sections outline the general Type I ambulance storage requirements. This section is divided into two sub-categories: interior storage and exterior storage. These two features will be studied for this project.

#### **2.3.1.1 Interior Storage**

Current federal specifications for interior storage compartments specify shape, size and type of compartment for every type of supply being carried in the ambulance. Storage compartments should be designed to accommodate all supplies required either by specification or by the purchaser. The storage compartments should include (but are not limited to) backboards, portable cots, stair chairs and other specified patient-carrying devices. Materials that are absorbent and not easily decontaminated such as carpet and fabric must not be used in any storage compartment or in the patient compartment.

The patient compartment must have a minimum of 35 cubic feet of enclosed storage cabinetry. This cabinetry may be located at the partition, sidewalls, overhead, seating areas and doors. It is unacceptable to locate storage compartments under the floor with panels that open into the passenger compartment.

Regulations state that door handles shall have near flush or low profile handles, and that drawers should be marine style slide or tilt design. All shelves must be removable, and storage compartments must be divided into sections for each type of item. Cabinets that are designed to carry lightweight items such as dressings, bandages, etc. shall have sliding doors that automatically latch, or that have friction holding devices when in the closed position. All doors should have locking latches that are bolted to the door and door frame and are designed to stay closed during transport. All cabinets should

be firmly attached to the structure of the ambulance via welding or bolts. Sheet metal screws may not be used to attach cabinets. The tops of cabinets and shelf surfaces should have a lip of at least ½” that is covered with a soft, pliable molding.



**Figure 8: Storage of various medical supplies and used hypodermic needles**



**Figure 9: Storage of various medical supplies and fluid and oxygen controls**



**Figure 10: Storage of medical supplies, towels and emergency blankets**



### 2.3.1.2 Exterior Storage

The exterior storage requirements for federally specified ambulances state that all exterior storage compartments must be water resistance, and must be equipped with either spring or pressurized gas type devices to hold the storage compartment doors open during use. All exterior storage compartments should have latches with keyed locks, and should also be automatically lighted when opened.



Figure 11: Storage of various emergency supplies



**Figure 12: Storage of stairchair and tools**



**Figure 13: Storage of backboards**

### **2.3.2 Communication**

The communication system specifications for current ambulances require a ventilated space for storage of a two-way radio, antenna openings, ground plane, terminal wiring for 12V power and ground (see appendix: Federal Specifications for the Star-of-Life Ambulance).

### **2.3.3 Lighting**

Federal specifications for ambulance lighting dictate light intensity requirements, requirements for instrument lighting, as well as requirements for automatic illumination systems.

In the patient compartment, the overall light intensity is to be no less than 15 foot candles as measured from the centerline of the compartment floor. In addition, the primary cot must be illuminated with light of at least 35 foot candles intensity over at least 90% of the cot surface<sup>3</sup>.

Patient compartment lighting must not utilize blue lights or lenses, and must not be powered by the vehicle's AC power system. The total dome lighting system must not consume more than 25 Amps of current while in the "bright" setting and must have two separately protected and controlled circuits. Both the patient compartment lighting and the exterior loading lamps must be automatically activated upon opening either the side or rear patient compartment doors.

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<sup>3</sup> See appendix: Federal Specifications for the Star-of-Life Ambulance



**Figure 14: Internal lighting layout**



**Figure 15: Internal lighting**

### **2.3.4 Climate and Sound Control**

There are several regulations that dictate allowed climate ranges and sound levels within the ambulance, specifically the patient compartment. All ambulances are to be fitted with sufficient heating, ventilation and air conditioning (HVAC) systems capable of producing clear air, and maintaining a temperate range of 68°F to 78°F in the patient compartment.

Federal regulations also state the maximum sound level within the patient compartment of the ambulance cannot exceed 80dBA at any time.<sup>4</sup>

### **2.3.5 Oxygen Storage and Supply**

Federal regulations specify that an ambulance must have a piped medical oxygen delivery system capable of storing and supplying a minimum of 3000 liters of oxygen. The system must be leak tested at 200 PSI and signed off by a qualified testing firm. The main oxygen supply will be from a single compressed gas cylinder that will be installed at the time the ambulance is placed in service.

The oxygen cylinder controls must be accessible from inside the ambulance, and a cylinder pressure gauge must be visible from the EMSP's seat. The cylinder must be accessible to be changed from the exterior of the ambulance.

Other requirements of the oxygen system are:

- Pressure Regulator
- Low pressure, electrically conductive hose approved for use with medical oxygen.

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<sup>4</sup> See appendix: Federal Specifications for the Star-of-Life Ambulance

- Oxygen piping that is concealed from the elements, securely supported, and readily accessible for inspection and replacement.
- Oxygen must be piped to a self-sealing duplex oxygen outlet station for the primary patient with a minimum flow rate of 100 LPM at the outlet.



**Figure 16: External storage of the oxygen tank**

### **2.3.6 Stretcher**

The modern ambulance stretcher has wheels that make transportation much easier, regardless of the terrain. An ambulance stretcher is basically a type of hospital gurney, or a narrow bed, on a wheeled frame that is typically adjustable in height. They are usually collapsible as well. Ambulance stretchers most often have a lock inside the ambulance that serves to secure the injured person during transport. They may also have or utilize straps to secure the patient or to prevent the patient from moving and thereby aggravating any wounds. The main objective of these stretchers is to prevent further injury and

provide safe transportation of the patient to ambulance, and then onto the emergency room.

There are two main types of stretchers used to transport patients from the scene of an accident to the ambulance, and then to the hospital. These two stretcher types are combination stretchers and conventional stretchers. In most cases, both stretchers have height adjustability, ranging anywhere from ground level to around 36." Additionally, most stretchers have backrest adjustability that allows tilt, ranging from 0° to around 75°. The difference between combination stretchers and conventional stretchers is the combination stretcher's ability to covert into a chair with wheels, used in situations where having a patient seated is the optimal position. The average stretcher weighs anywhere from 50lbs to 100lbs. Below are images that show the differences between combination and conventional stretchers.



**Figure 17: Conventional stretcher (ref. 20)**





**Figure 18: Combination stretcher (ref. 20)**



### **3. Design**

From the background research complete, an extensive understanding of the physical attributes of the current ambulance design has been gained, as well as the functions of each particular component within the patient compartment. With these, the next step in the design process is to identify areas within the patient compartment that could benefit from design improvement, focusing on the areas that behold the most room for improvement. For this particular project, the entire patient compartment was taken into consideration for redesign, including both interior and exterior features. The main goals of the new design concepts were to improve space utilization and supply accessibility, EMT safety and mobility, and ergonomics.

#### **3.1 Areas of Focus**

The following sections outline the eight main areas of focus that were chosen to be studied for possible improvement during the design process. These areas have the greatest room for improvement, and redesign of these features would lead to the greatest overall improvement in the performance, efficiency and ergonomics of the ambulance, specifically the patient compartment.

##### **3.1.1 Storage Efficiency**

The current design of most Type III ambulances utilizes storage cabinets that do not provide the most efficient storage possible for many items. Space in the interior of the ambulance is important for patient and caregiver mobility, and storage cabinets should be designed to maximize the length and width of the patient compartment at the floor level. Storage cabinets in existing ambulances, however, protrude farther than necessary into the patient compartment at the floor to mid-body level, and the widest part

of the patient compartment interior is located at head height. This adds to the illusion of space within the patient compartment, though the extra width at head height is not useful when the caregiver and patient are sitting and lying down respectively.

The biggest contributors to the storage space inefficiency of the current ambulance design are the externally accessible storage compartments. The compartments are large boxes that protrude into the ambulance interior and are the reason for the narrowness of the ambulance interior. As illustrated in the following images, much of the space within the current externally accessible compartments is unnecessary.



**Figure 19: External storage of auxiliary tools**



**Figure 20: External storage of stairchair and tools**

The internally accessible storage compartments on the current Type III ambulance are also lacking in efficiency. The interior compartments are designed in the same manner as the externally accessible compartments. They have a high volume that allows many supplies to be stored in them, but the deep and narrow design makes them protrude excessively into the ambulance interior. This protrusion limits available space for EMTs and Paramedics to move, and the deep design tends to increase clutter within the compartment because items must be arranged in rows behind one another. This hampers the caregiver's ability to quickly locate a single item. Examples of cluttered interior storage compartments are shown below.



**Figure 21: Upper internal storage compartment**



**Figure 22: Middle and lower internal storage compartments**

### **3.1.2 Weight Distribution**

Weight distribution refers to the variation of weight within the ambulance. Ideally weight should be distributed as close to the floor as possible, and storage compartments should be spaced evenly around the perimeter of the ambulance. The current design of the interior cabinetry and external equipment storage compartments is biased toward the left side of the ambulance. This uneven distribution leads to problems with suspension, decreases cornering capabilities during right-hand turns, and increases the probability that the ambulance will roll over during aggressive maneuvering.

### **3.1.3 EMT Mobility and Safety**

The mission of an ambulance and its crew is to preserve the life and aid in the wellbeing of a patient in distress. This mission, however, comes second to preserving the wellbeing and safety of the individuals who are responsible for taking care of the patient. Should an unforeseen accident occur while the ambulance is en route to the emergency site or to the hospital, the safety of the EMTs and Paramedics is extremely important. Endangerment of one individual to save another is counterproductive, and all possible steps should be taken to avoid this scenario. The current Type III ambulance design illustrates two separate seating locations for the primary caregiver.

The first seating position, illustrated below, places the caregiver in a seat alongside the patient, allowing them easy access to the patient while en route to the hospital, but providing few safety precautions in case of an accident.



**Figure 23: EMT seat adjacent to stretcher**

This seating location leaves the caregiver extremely vulnerable to side impacts due to the seat's immediate proximity to the outer wall of the passenger compartment. It also leaves the caregiver vulnerable to spinal or neck injuries in the case of a front end collision as the lap belt does not provide lateral support, and the cabinet on the forward side of the seat is approximately at head level.

The second seating position provides the seated individual with a much greater level of safety from impacts in all directions, but greatly decreases access to the patient. This seat may be adequate in scenarios where the patient does not require constant physical attention from the caregiver, but as shown below the seat cannot be used if the patient requires the attention of the caregiver.



**Figure 24: EMT seat at front of patient compartment**

### **3.1.4 Waste Management**

Both biological waste and standard waste can be created during the process of caring for a patient. It is important for this waste to be disposed of quickly and correctly to maintain a safe environment for the EMT, patient, and future patients.

Two major considerations are contaminated towels used for cleanup of bodily fluids, and used hypodermic needles. In current ambulance designs, used hypodermic needles are put into a plastic container on the wall with a one-way door. This system ensures that the syringes do not come back out under normal operation. Once the container has been filled, the entire container is removed from the ambulance and disposed of elsewhere. In the event of a crash, however, it may be possible for the container containing the needles to be broken. If an event like this were to happen the



needles could become hazardous to the health and safety of all occupants of the patient compartment.

Towels or sheets contaminated with blood, or some other type of contaminate do not currently have a safe storage location and are removed from the ambulance when the patient arrives at the hospital. These dressings also pose a contamination hazard in the event of an accident.



**Figure 25: Current storage of used syringes**

### **3.1.5 Materials**

The high weight of current Type III ambulance designs is detrimental to handling ability, vehicle longevity, and fuel consumption. The average weight of a fully equipped Type III ambulance is 12,000lb. A driver attempting to maneuver a vehicle of this weight around obstacles in the road must utilize extreme caution to avoid rolling the vehicle over, or exceeding the braking capabilities of the vehicle.

In addition to the hazard of limited maneuverability, a six ton vehicle being driven at a relatively high rate of speed over fairly irregular road surfaces places a great deal of additional wear on the suspension and drivetrain parts. This extra wear decreases the lifespan of the vehicle and adds to the expense of maintaining the ambulance service.



A third concern associated with high vehicle weight is fuel consumption. Because ambulances still rely on diesel oil and gasoline, resources that are both increasing in cost and decreasing in social acceptability due to their association with climate change, reducing fuel consumption and increasing ambulance efficiency is important. One way to increase fuel consumption is to decrease the overall vehicle weight.

In order to create a more maneuverable, longer lasting, and more efficient medical transport vehicle, methods for reducing overall vehicle curb weight will need to be implemented.

### **3.1.6 Lighting**

For an EMT to be able to give care effectively it is important that the patient be illuminated sufficiently. On the ceiling of the ambulance there are numerous lighting fixtures. The different fixtures allow caregivers to vary the amount of illumination in the patient compartment to fit the situation. The bulbs in the ceiling are generally incandescent bulbs, which get hot when operating. The extra heat provided by this type of light can be beneficial in the winter, though in the summer they contribute to high temperatures within the ambulance. Because heat given off from the ambulance engine is essentially a waste product, and air conditioning requires additional fuel, a cooler lighting system is the most overall energy efficient option.

Natural lighting can be utilized to some extent during the day, though the intensity of the natural light that enters the ambulance is often low. This is due to the fact that ambulance windows are almost always heavily tinted to keep people on the exterior of the ambulance from being able to see inside. For this reason, ambient natural light is not adequate for patient compartment illumination.



**Figure 26: Current lighting in the patient compartment**

### **3.1.7 Climate Control**

Maintaining a temperate environment within the patient compartment of the ambulance is important to patient and caregiver comfort during transport. In both the winter and summer months it can be difficult to maintain a comfortable temperature balance because of large variations in external temperature. In addition to an effective heating and cooling system, patient compartment insulation is important to helping to efficiently maintain temperature within the ambulance.

### **3.1.8 Automation**

Current ambulance designs do not have many automated systems to aid caregivers in performing their duties. If an item is needed for patient care, the caregiver must locate the item among many other items within the stationary, high capacity cabinets. If items have been moved or have fallen down among other items, the process of item location can waste precious time. With recent advances in computer controlled automated systems, computer size, and computer interfacing technology, automated systems could

be designed and implemented into ambulances to increase ergonomic efficiency and facilitate rapid patient care.

### **3.2 Design Ideation**

After conducting research on the current ambulance design, seven main areas of focus were selected for the new design concept. The areas are listed below, and were initially selected because of their relative importance to patient care, as well as their ability to be improved.

In order to provide adequate care for a patient, the EMTs must have medical supplies and instruments at their immediate disposal. In the extreme case, an inability to quickly access a certain medication or piece of equipment may drastically lower the patient's odds of survival. It is for this reason that storage capacity and accessibility is the first priority in the redesign process.

Current ambulances have large storage cabinets that are very deep but do not utilize much of the width available on the walls of the patient compartment. The high volume storage cabinets are intended to increase ease of access to medication by concentrating the medication in focal locations. This system is flawed, however, because the clutter that can accumulate within a deep cabinet can hamper the EMTs ability to quickly locate supplies.

In addition, the deep cabinet design is an inefficient use of potential working space within the patient compartment. Because the cabinets are deep, they reduce the amount of space available for EMTs to move around the patient in transit. This lack of mobility can translate to less desirable working conditions for the EMT and therefore compromised patient care.

Internal temperature of the ambulance is very important for the comfort of both patients and EMTs. In the winter months, maintaining an acceptable temperature within the patient compartment of the ambulance can require the engine to be running almost constantly. This both wastes fuel and pollutes the environment.

In addition to temperature regulation, minimization of vibrations is very important to both the patients and EMTs during transport. Noise due to small vibrations can add to the stress of a trauma situation.

Insulation technology advancement can help to solve both the problems of temperature regulation and noise causing vibration.

When loaded with all necessary supplies and equipment, current ambulances weigh in close to the GVWR of the vehicle upon which the ambulance is built. This places a great deal of stress on the chassis and suspension, and shortens the overall life of the vehicle. To combat this effect, newer ambulances are being constructed on larger truck platforms. This is also a problem, however, because the vehicle rides much more stiffly with larger truck suspension – thus creating a much more jarring ride for the patient and EMT.

In addition to the high weight of current ambulances, many of the heavier supplies are stored in cabinets that sit high above the chassis of the vehicle. Often supplies are unevenly distributed between the left and right side of the ambulance as well. These factors contribute to an unstable vehicle layout and compromises drivability in tight traffic situations.

Ambulance communication currently takes place via radio. Though this is a simple and inexpensive system, there have been so many advances in data

communication in recent years that an enhanced communication system would be beneficial. Improved communication would ideally allow data such as photographs and video to arrive at the hospital before the patient, creating greater preparedness at the time of the patient's arrival.

Currently biological waste is stored relatively unrestrained within the patient compartment of the ambulance. This creates a contamination hazard within the work environment, and a potential hazard in the event of an accident. Improved capacity to immediately deal with contaminated waste is essential to the improvement of the ambulance.

The ability for EMTs to move around the patient is imperative, though in current ambulances this causes compromised EMT safety because they must leave their seats in order to relocate within the patient compartment of the ambulance. In an ideal ambulance, EMTs would have full access to the patient and supplies within the ambulance while still remaining buckled in to a seat. This would greatly improve safety for the caregiver.

Patient treatment and drug delivery is currently limited to the skill of the caregivers that are riding in the ambulance with the patient. An advanced treatment and drug delivery system that is combined with a technologically advanced communication system might allow surgeons and doctors to begin working on the patient before they even reach the hospital. While the EMTs are there to position and stabilize the patient, it is not unfeasible to have a remotely operated surgeon or other such device available within the ambulance to immediately perform advanced medical procedures.

### **3.2.1 Storage Efficiency**

A vital feature of the patient compartment is the storage system that houses all the medical supplies and emergency tools used by the EMTs on a daily basis. Currently, the storage layout is less than optimal; there are large, cube-shaped compartments with only a portion of the space being utilized, smaller compartments overfilled with necessary supplies, and other compartments that hold vital supplies located far away from the EMT chair. This makes timely and safe treatment and drug delivery difficult, as the EMT has to worry about finding and attaining supplies on top of caring for a patient, which can prove to be extremely trying during treatment of a massive trauma patient. Additionally, externally stored items, such as the backboards, stair chair and emergency tools, are all vertically arranged, create a high center of mass for the patient compartment. These compartments also protrude deeply into the patient compartment, greatly narrowing the working space inside, which makes it much harder for EMTs to deliver treatment to patients. By strategically changing the storage layout, a much more efficient method of storing supplies can be achieved, and also the ability of EMTs to get supplies and administer care to patients can be greatly improved.

To improve the current storage efficiency in the patient compartment, two main areas of focus will be studied for redesign: storage volume and improved space utilization.

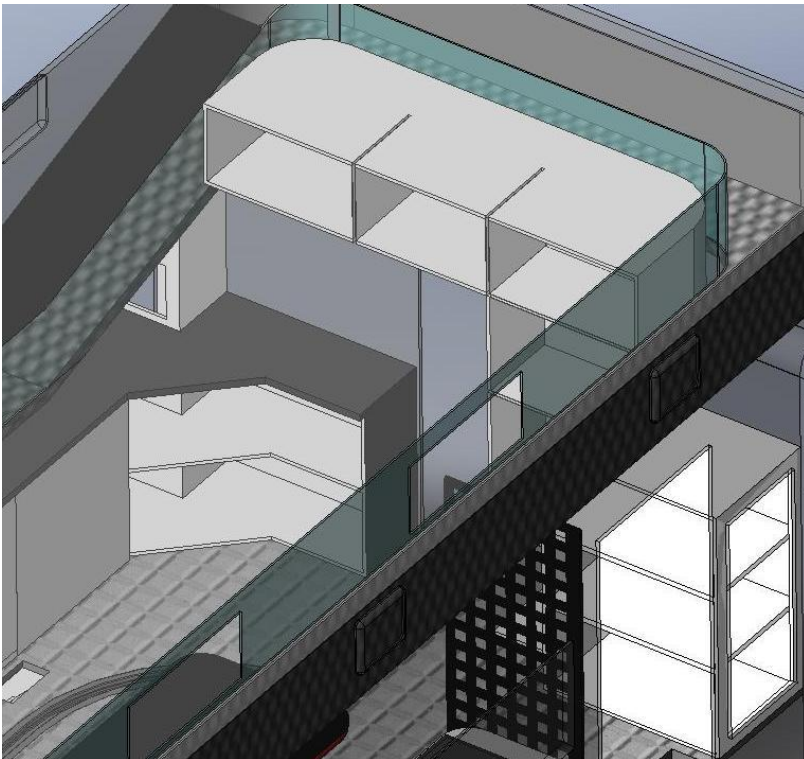
#### **3.2.1.1 Increased Storage Volume**

By increasing the storage volume, the distribution of current supplies can be changed such that cluttering and disorganization of supplies does not occur. With increased storage volume, the same amount of supplies in the current ambulance can be

dispersed over a larger area, thus making it easier to organize items and enable easier access to such items.

In addition to this, more supplies could be carried, enabling the ambulance to remain on call without needing to go back to the fire station or hospital to restock the supplies it must carry at any given time. This increase in active duty time will increase the efficiency of the overall emergency response process, and could possibly enable the decrease of the number of needed ambulances, cutting down costs immensely, both of the ambulance itself and labor of the EMTs.

The new design has nearly 300% more storage volume of the required 35 cubic feet, as mandated by the Federal Specifications for the Star of Life Ambulance (see appendix). This increase in storage capacity enables the implementation of the above mentioned possibilities, which will greatly improve ambulance efficiency.



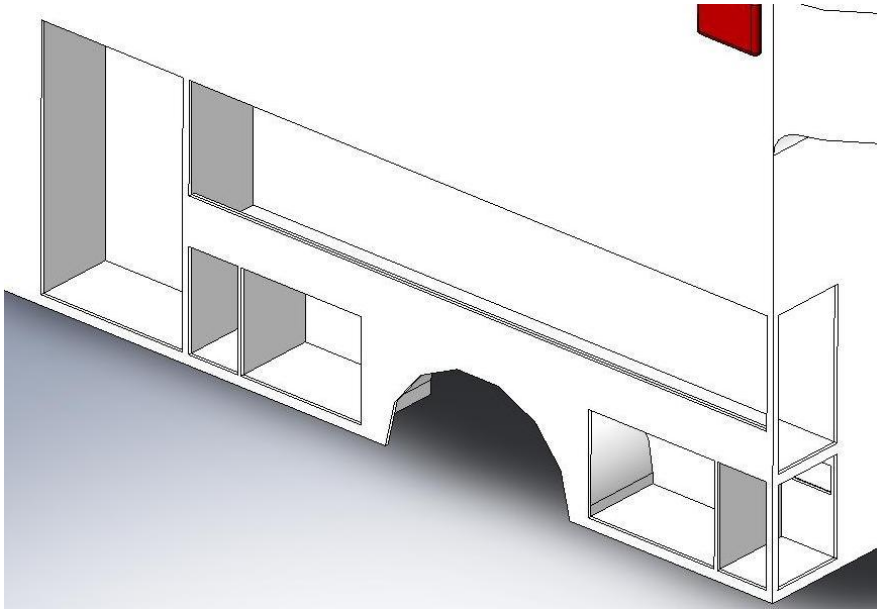
**Figure 27: Increased internal storage capacity**

### **3.2.1.2 Improved Space Utilization**

In addition to increasing storage capacity, improving the ergonomics of the storage compartments can greatly improve the efficiency of the storage system. The current storage cabinets are large and oddly shaped; some compartments are shaped in such a way that only a portion of their volume is being used. Additionally, these cabinets, specifically the external cabinets, tend to be extremely deep, upwards of two and half feet deep in some models. These deep cabinets protrude into the patient compartment, causing a very narrow work area for the EMT to administer care. These problems can easily be alleviated by more appropriate storage compartment shapes and layout.

The new design reconfigures the external storage compartments such that not only do the shapes of each individual compartment more efficiently house supplies and decrease wasted space, but also changes the layout of the compartments. The compartments are now much less vertical in layout, and are oriented horizontally, stretching nearly the entire length of the patient compartment, and subsequently mostly at or below floor level. This not only makes supplies easier to reach, but it also lowers the center of mass of the compartment, as the externally stored supplies and tools are the heaviest items stored in the ambulance. These new cabinets are much shallower, having a maximum depth of approximately 16". This increases the internal working area greatly, allowing greater mobility of the EMT. Finally, the storage conveyor system improves both of these areas immensely, which will be discussed in a later section.





**Figure 28: External storage: driver side**

### **3.2.2 Weight Distribution**

Maintaining a balanced weight distribution is an important part of improving the handling characteristics of an ambulance. One of the problems associated with current Type I and Type III ambulances is that the weight is distributed with a significant bias towards the left side of the vehicle. The oxygen tank, external storage compartments for tools, and most of the medical supplies are stored on the left hand side of the vehicle. This means that the driver must use caution when executing right hand turns in order to avoid overturning the ambulance.

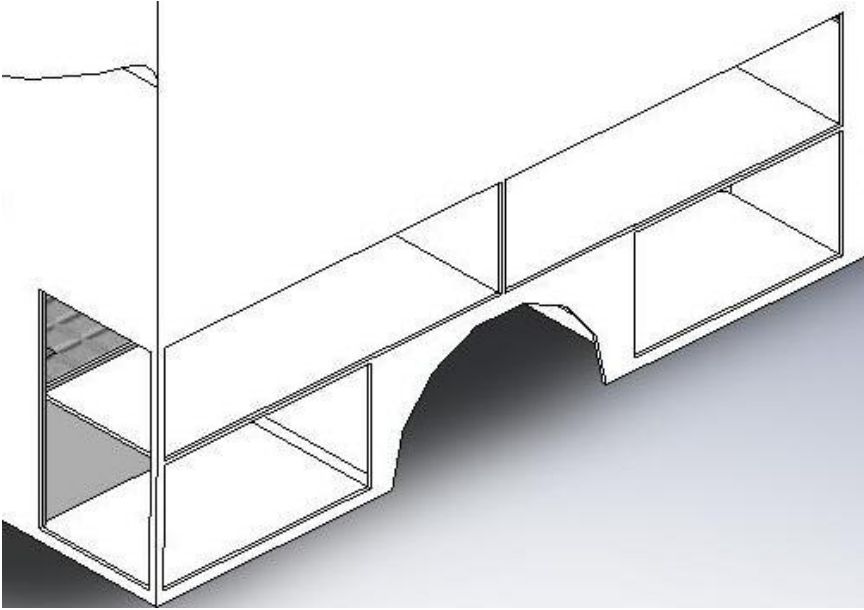
The fact that the ambulance is currently more nimble when making left hand turns means that drivers will instinctively dodge obstacles in the road by swerving to the left. This instinct is a potential hazard to oncoming traffic, and could be made less prominent by properly balancing the ambulance from left to right.

#### **3.2.2.1 External Storage Reconfiguration**

The new design addresses the issue of imbalanced weight distribution by changing the location and orientation of storage compartments. The oxygen tank, tool boxes, stair chair, and miscellaneous supplies are all currently located on the left side of the ambulance. Backboards are located on the right hand side in a vertical storage compartment at the rear of the ambulance. The new design features external storage spaces symmetrically located on either side of the ambulance. This will allow heavy items to be stored on both sides of the ambulance to balance the weight.

In addition to left-right weight distribution, weight distribution from ground level up is also important to improving the handling characteristics of the ambulance. The new design features lightweight composite shelves and cabinets to reduce the overall weight of the patient compartment wall assemblies. This reduction in cabinet weight will shift the center of mass of the ambulance down towards chassis-level, increasing ambulance maneuverability and improving drivability.

The external storage compartment relocation also helps to lower the center of mass of the ambulance. The spaces have been located as close as possible to wheel-level. The lower position of the storage spaces will help to keep the center of mass as close to the ground as possible.



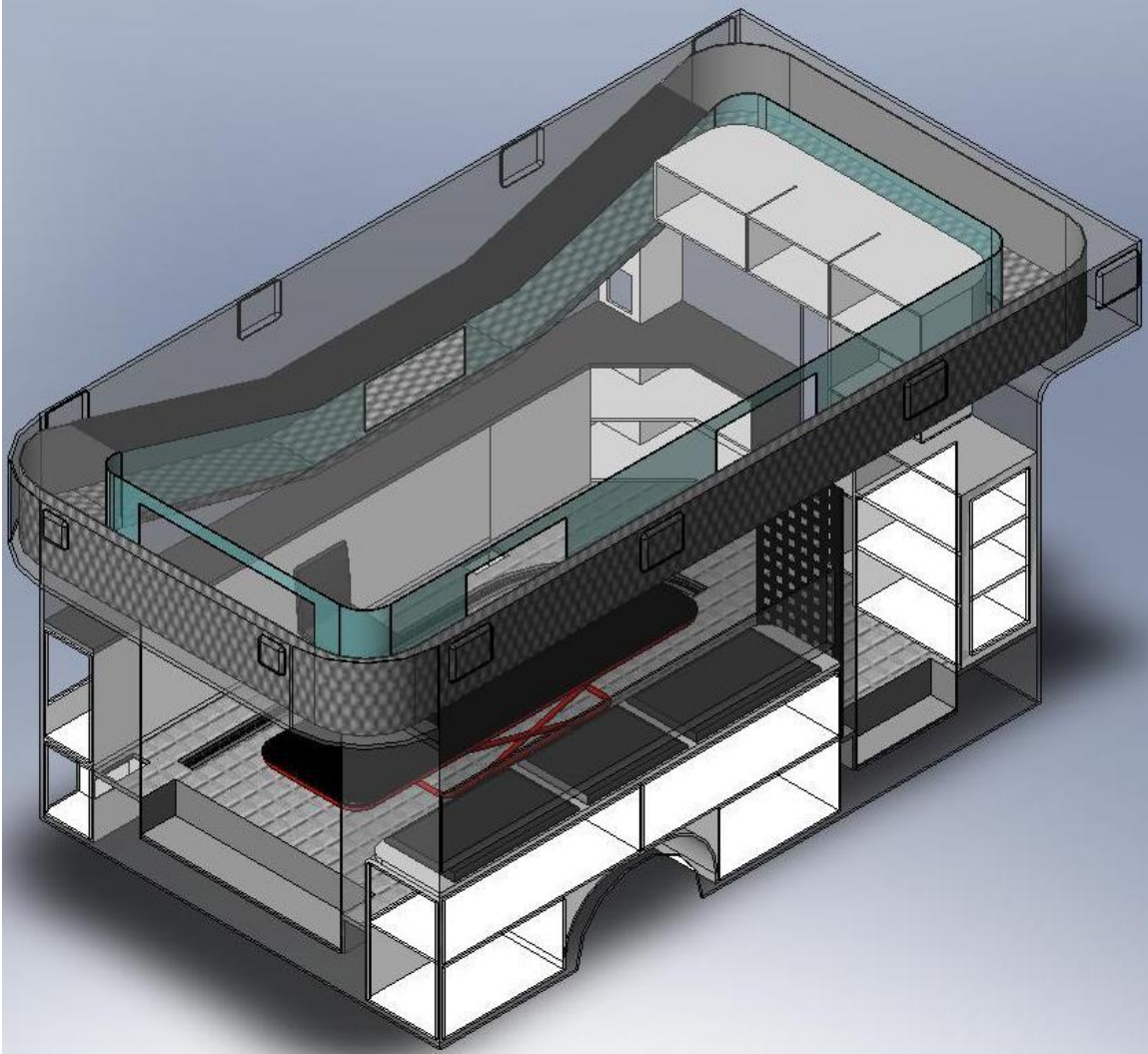
**Figure 29: External storage: passenger side**

### **3.2.2.2 Internal Storage Reconfiguration**

The current layout of internal storage compartments consists of cabinets and storage spaces that are located on the sides of the patient compartment. Distribution of weight over the centerline of the ambulance helps to keep the ambulance balanced during maneuvers in traffic. The new design features a unique internal storage system that contributes to accessibility of supplies, and to the overall balance of the ambulance.

The conveyer belt medication storage track that loops around the circumference of the patient compartment places roughly 1/3 of the total supplies on the track in cabinets that are perpendicular to the direction of ambulance travel. The weight of the items in these portions of the track is no longer over the left or right side of the ambulance, but distributed across the centerline of the ambulance. This helps to maintain a more even distribution of the internally stored medications and supplies, and will improve handling characteristics of the ambulance.

In addition to the track system, bulky equipment items have been relocated from large cabinets on the left side of the patient compartment to centrally mounted storage compartments. The storage compartments are mounted on the wall directly behind the cab of the ambulance, and will help to relocate some of the heavy items that were previously being stored along the left side of the ambulance.



**Figure 30: Internal storage layout**

### **3.2.3 EMT Mobility and Safety**

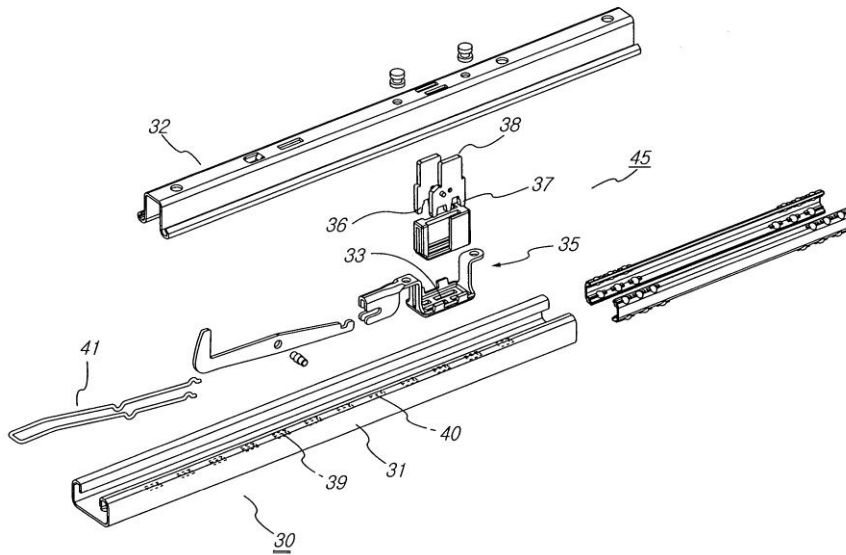
A major concern regarding ambulances is the mobility and safety of the EMTs performing care and treatment to patients on a daily basis. Currently, the EMT is either forced to be strapped into a single, stationary seat, located between square-edged cabinets at approximately the abdomen of the patient. This means that the EMT must get out of his seat to get supplies located on the opposite wall, and more importantly, to have full access to the patient's head, which is crucial in administering care to the patient. The new design looks into possible solutions to allow greater mobility of the EMT while simultaneously providing greater safety measures than the current design.

#### **3.2.3.1 Sliding Track Chair System**

A new concept that is a main highlight of the new design is the idea of a sliding track system for the EMT chair. This system will allow much greater mobility of the EMT, allowing greater access to both more supplies as well as the entire body of the patient. This design incorporates two main features; the sliding chair itself, along with a shock absorbing system to safely slow the chair down in the event of sudden braking or an accident, ensuring the safety of the EMT.

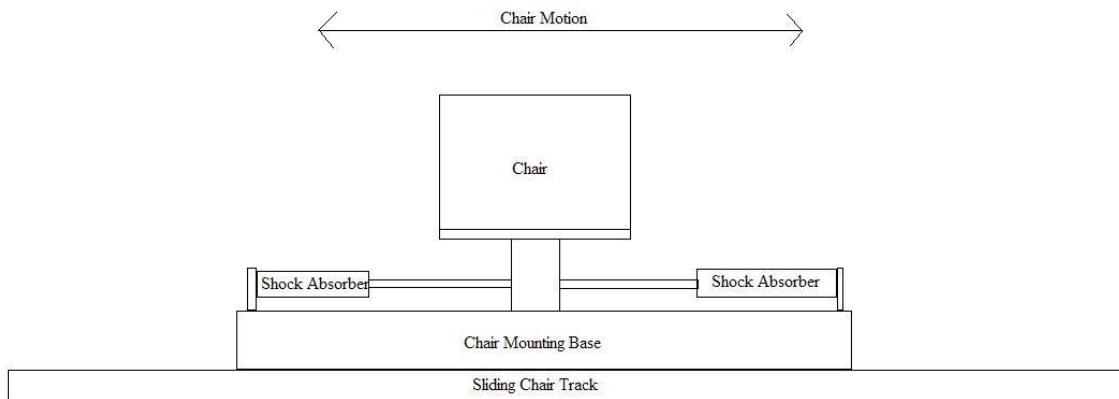
The chair can be used two ways; the first as a free-motion, sliding chair, the other as a locked-position, stationary chair. The chair can utilize a system similar to the locking track system on the front seats of an automobile. A series of toothed rails in the floor can be used to catch the locking mechanism on the chair, which will catch when the EMT applies the lock when at the desired location in the track. When the EMT wants to slide to another position on the patient, he simply has to manually release the lock, and the

catching mechanism will release its contact with the toothed rails, allowing the chair to slide once again.

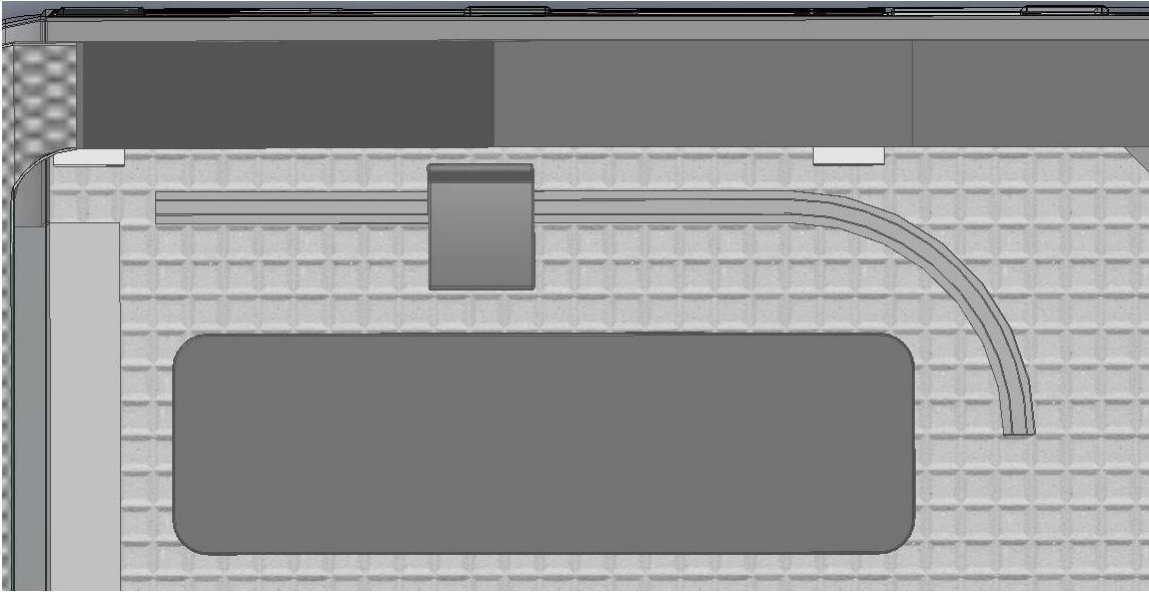


**Figure 31: Locking chair mechanism (ref. 18)**

To prevent the chair from sliding uncontrollably in the event of an accident or sudden braking, a shock absorber system can easily be implemented into the base of the chair, below the floor. This will enable the chair to move along the track, while always maintaining a system to absorb shock and safely decelerate the chair, regardless of its position in the track.



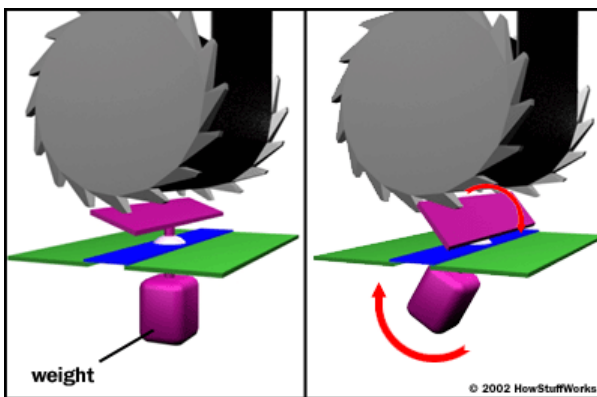
**Figure 32: Chair shock absorber diagram**



**Figure 33: Sliding chair track**

### **3.2.3.3 EMT Harness System**

The EMT harness system is a hybrid of existing technology and modern engineering innovation. A five point harness system with leg, waist and chest loops would be worn by the EMT. This harness would buckle in to retractable straps on the EMT seat that would allow the EMT relative freedom of movement in the immediate vicinity of the mobile seat. The retractable straps will have an arrest system built in to them similar to the system pictured below that is found in most commercial automobiles.



**Figure 34: Seatbelt locking system (ref. 19)**

Because the seat is able to rotate and move within the ambulance, however, standard forward facing mechanical pendulums are not reliable enough to ensure belt locking in the event of an accident. These pendulums would be replaced with servo motors with voltage input from accelerometers mounted at the corners of the vehicle. In the event of acceleration above a certain threshold, the accelerometers would give a signal to the servo motor to rotate and lock the belts in position. This system allows a much greater degree of safety to the EMT while still allowing her to perform unrestricted work on the patient.

### **3.2.4 Waste Management**

Ideally waste within the patient compartment of the ambulance will be fully contained and sealed from the EMTs working on the patient. Due to the fact that EMTs must be able to frequently and quickly access the waste disposal area, any waste disposal systems must be easily reachable and quickly opened, in addition to the requirement of allowing only one-way flow of contaminated waste.

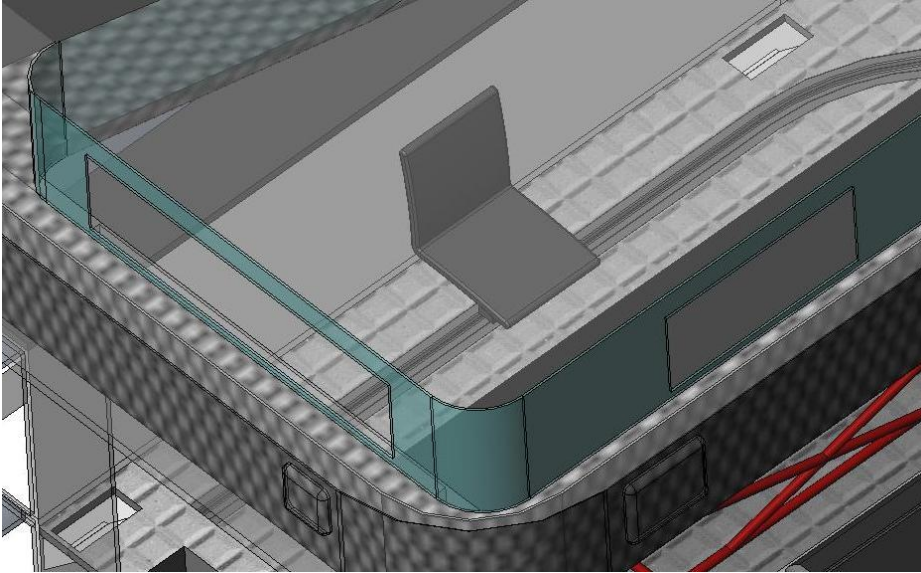
The most common types of biological waste within the ambulance are used “sharps” or hypodermic needles, and fluid soaked linens and towels. In the current ambulance, sharps are deposited in the sharp collection box that is generally attached to the wall in the patient compartment. As long as the box is not broken or dislodged during an accident, this provides a safe means of disposal for the needles.

Soiled linens and towels, however, are currently discarded on the floor of the ambulance. If a patient is contaminated with an infectious disease, EMTs could be exposed to the disease if these soiled linens are thrown during an accident. It is for this

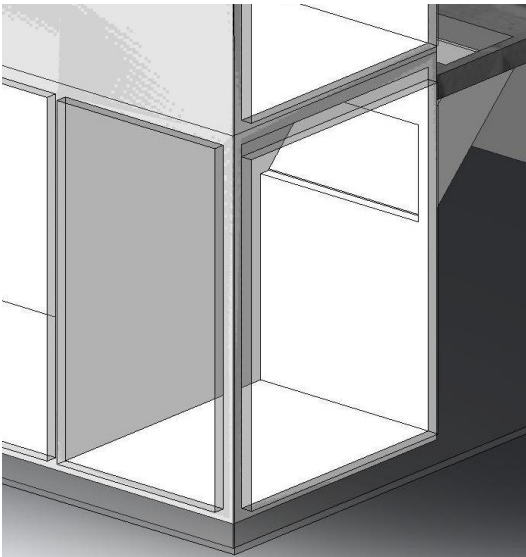


reason that the new ambulance design features a waste disposal container under the floor with a one-way spring loaded door.

The waste disposal container has a removable and replaceable liner that allows for simple decontamination after use, and it provides a safe means of storage for otherwise potentially hazardous biological waste.



**Figure 35: Waste disposal chutes**



**Figure 36: External waste access**

### **3.2.5 Weight Reduction**

Reduction of ambulance weight can be achieved through the selection of lighter materials for use within the ambulance that still have high strength and durability. A number of different composite materials are available including carbon fiber reinforced polymers and glass reinforced polymers. Both of these have very high strength and toughness properties, and are much lighter than the steel that is currently used for cabinet structure. In addition, polymers can be molded by machine and do not require as much manual fabrication as metal cabinets. This will save on both manufacturing and installation costs. Though the cost of fiber reinforced material is higher than steel, the factors of weight reduction and decreased manufacturing cost should override the increase.

Weight reduction could also be achieved through the implementation of a new, lightweight oxygen storage system. In this system, oxygen for patient treatment would be stored in a collapsible lightweight container in the ceiling of the ambulance. In the event of a rollover accident, the oxygen would be immediately vented to atmosphere through a number of vents in the ceiling to avoid explosion in the patient compartment. This system would save the significant weight of the large oxygen tank that is currently present in the ambulance.

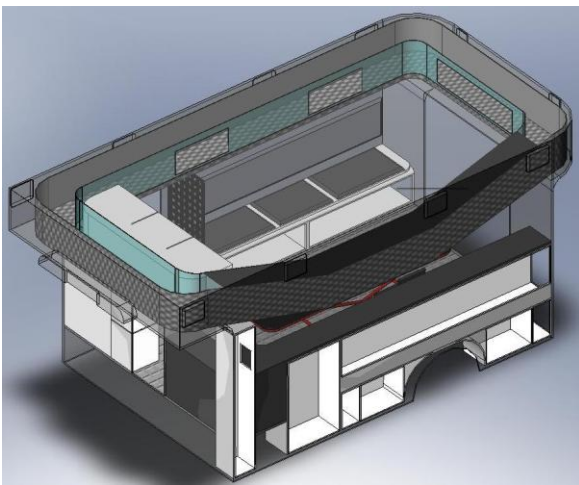
### **3.2.8 Conveyor Storage System**

The new conveyor storage system is designed to allow an EMT to sit safely in his or her chair throughout the ride to the hospital by having supplies delivered to the EMT instead of having the EMT reaching around precariously.

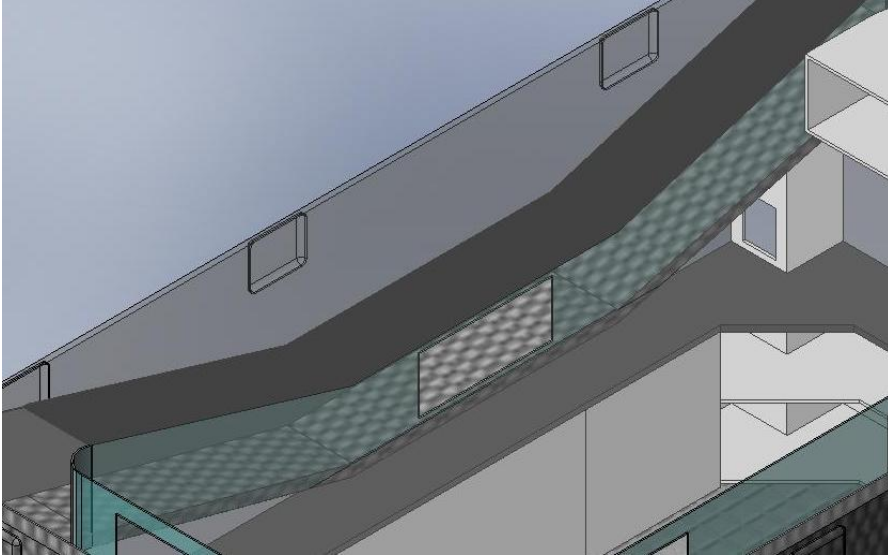
The conveyor belt will be powered by a high power motor located toward the front and middle of the ambulance so as to help maintain weight distribution. In case of power loss to the motor or if the motor breaks down a hand crank will allow the conveyor to be rotated around its track. There are several openings allowing access to the contents of the conveyor, these are designed so another paramedic positioned some place besides the chair can access supplies on the belt.

Items will be grouped in individual compartments on the conveyor according to how they are used. If a patient is suffering from a heart attack, the paramedic will select the heart attack compartment and every item necessary to treat the patient will be accessible by the EMT instead of the EMT having to select each item individually. This should reduce the amount of movement the EMT has to do to get supplies significantly resulting in faster patient care, possibly saving more lives.

The paramedic will select which compartment is needed by selecting it on a touch screen computer located on a wall near to the chair for easy access. This technology can be upgraded in the future to possibly contain voice recognition software such as that in cell-phones to further speed up the process of selecting the correct compartment.



**Figure 37: Storage conveyor access doors**



**Figure 38: EMT access to supplies**

#### **4. Conclusions**

The new ambulance design features improvements to many of the most important ambulance features. The interior layout will provide EMTs with rapid access to medical supplies and medications, as well as a more comfortable and maneuverable workspace. In addition, the conveyer storage system allows supplies to be stored in the fore and aft extensions, increasing the available volume within the patient compartment.

The ability of the EMT to safely work on the patient is greatly improved because of the sliding track mounted EMT seat with retractable harness. This system allows the EMT to remain strapped in while working on the patient, therefore avoiding more serious injury in the event of an accident. Other safety improvements are the waste disposal system and the reduction of sharp corners within the patient compartment. The containment of contaminated waste reduces the risk of EMT infection in the event of an accident. The streamlined interior design reduces the risk of impact related trauma should the ambulance stop short or accelerate quickly.

Exterior storage compartment reconfiguration lowers the center of mass of the ambulance. The horizontal storage of tools and supplies also diminishes the risk of EMT injury due to falling supplies that have shifted during transport. The sealed external compartment design reduces the risk of contaminating the patient compartment from the outside environment. This feature will be most useful for calls during storms with wind and precipitation.

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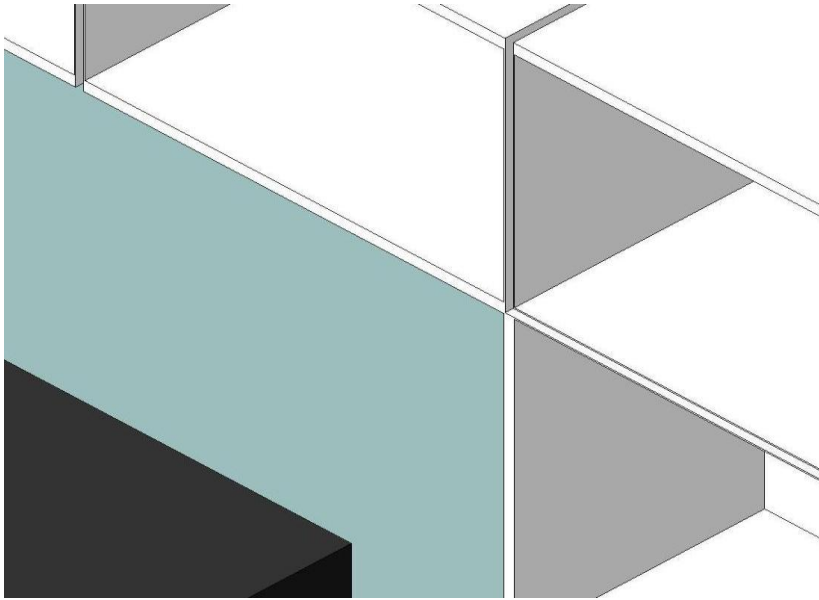
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After presenting the new ambulance design concept to EMTs and officials from UMass Memorial Hospital, a few critical design changes were made based on the suggestions that were made. The design changes are illustrated below.

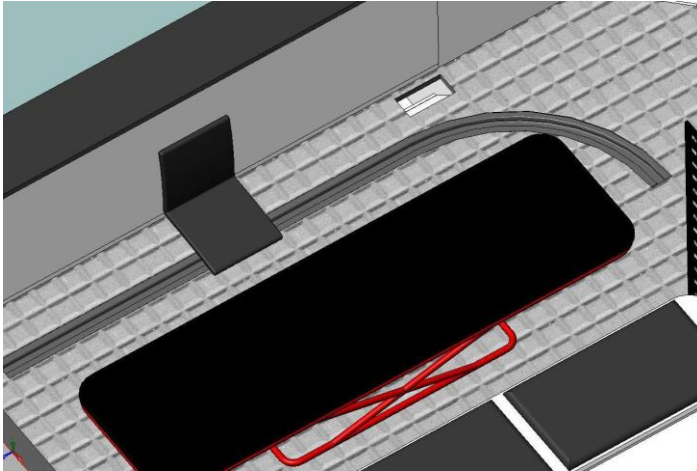
- The ambulance cabinets can be subjected to a relatively high level of abuse, and it is not uncommon for cabinets to be broken or deformed. Because of this cabinets and storage compartments should be easily repairable or replaceable. Because

one-piece composite cabinets may be more difficult to repair or replace, the cabinets could be made of multiple sections of composite material that can be bolted together. In addition to making cabinets easier to repair, the cabinet layout is more easily customizable to meet the needs of the EMT team.



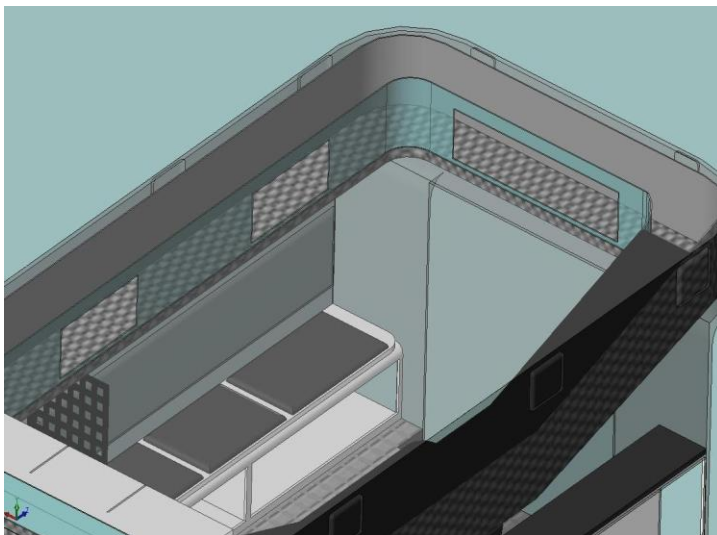
**Figure 39: Compartmentalized storage cabinets**

- Many emergency response calls involve patients that must have special attention paid to the head. Spinal injuries require the EMT to be in a position to stabilize the head, and access to the airway is imperative during CPR administration. The initial sliding track design did not allow the EMT chair to move out and around the end of the stretcher. This design would not allow the EMT to have straight-on access to the patients head. To remedy this, the track design was changed to curve around in order to allow this access.



**Figure 40: J-shaped EMT chair track**

- In the event of a failure of the motor that drives the conveyer storage system, it is imperative that EMTs still have access to medications and supplies. To allow access to medical supplies during a motor failure, the track was redesigned with multiple access windows along its entire perimeter. In addition to the windows which allow access to 80% of the track at any given time, a manual hand crank will allow access to the supplies that are inaccessible in the front portion of the track.



**Figure 41: Multiple conveyor access doors**



Future work on the ambulance should delve further into many topics such as communication between the ambulance and the hospital, a drug treatment delivery system, possibly an arched roof, as well as other things.

With an advanced communication system paramedics in the ambulance could learn quickly about any allergies a patient may have. A new drug delivery system might find a way to have retractable tubes that come from the ceiling like oxygen masks from the ceiling of an airplane. An arched ceiling on an ambulance offers less wind resistance at high speeds and might lead to a lower center of gravity, helping with cornering.

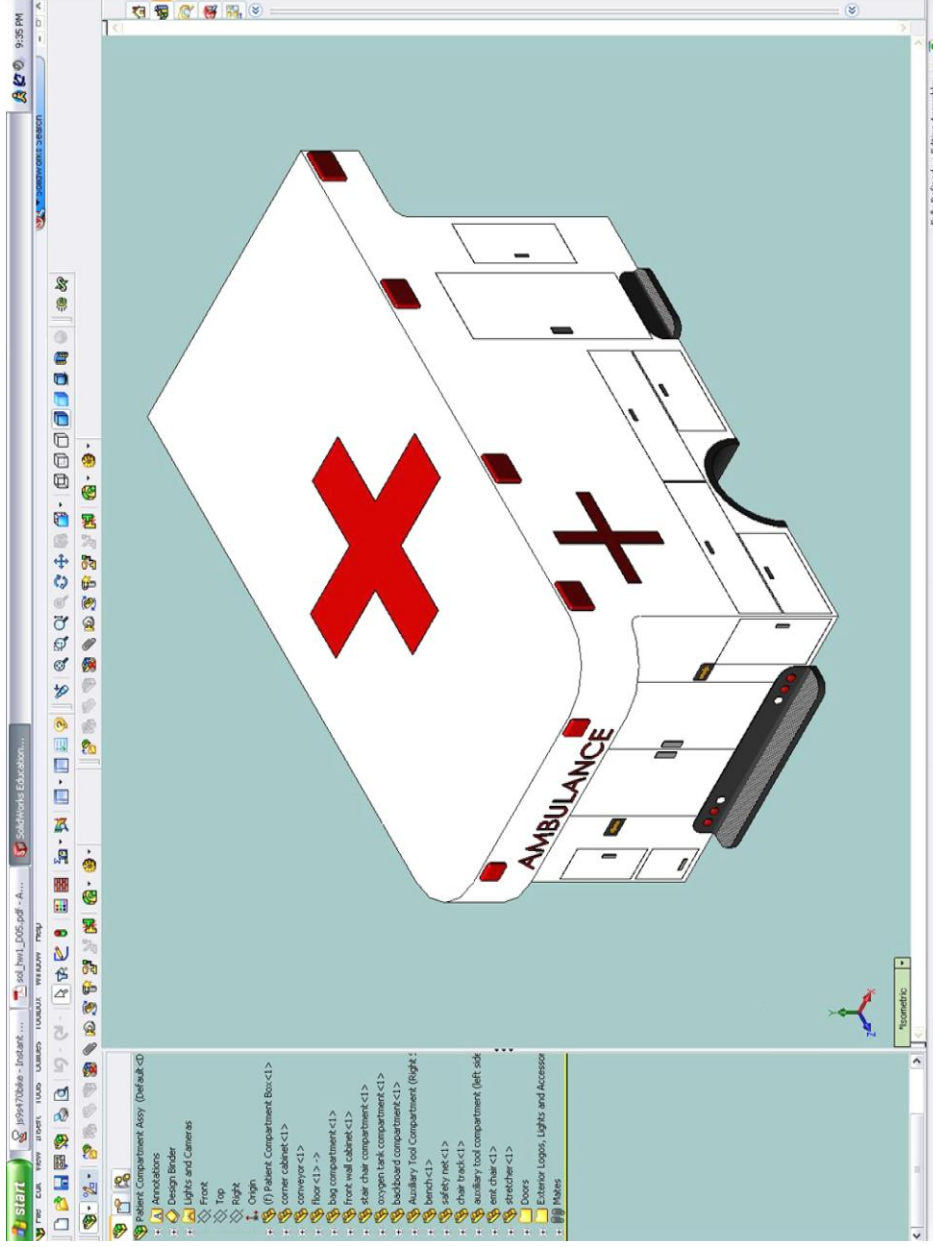
A new ambulance design will incorporate many new technologies, possibly some that haven't been invented yet. This design is only a start towards a greater project that will hopefully lead to a much better ambulance and to more lives saved.

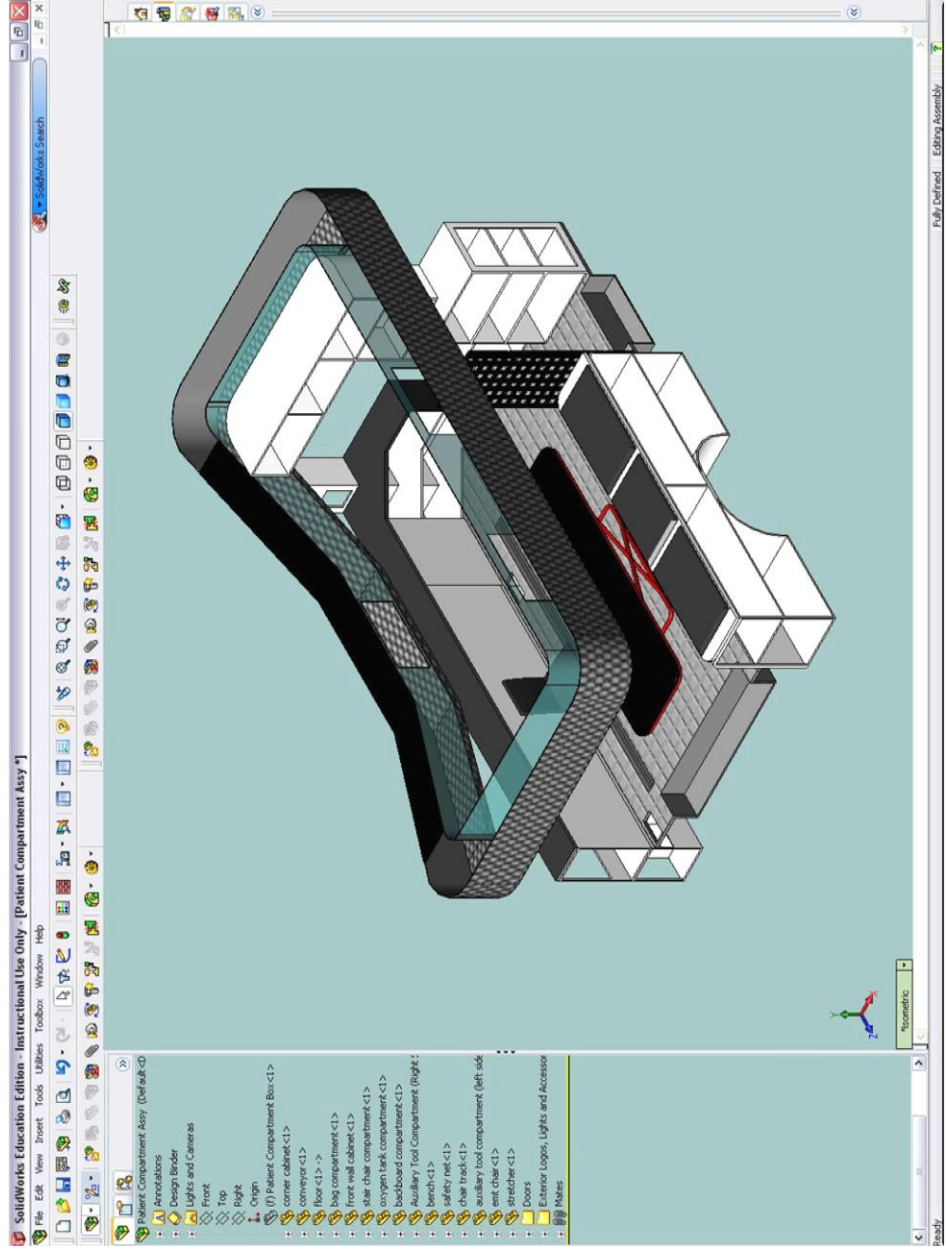
## **5. References**

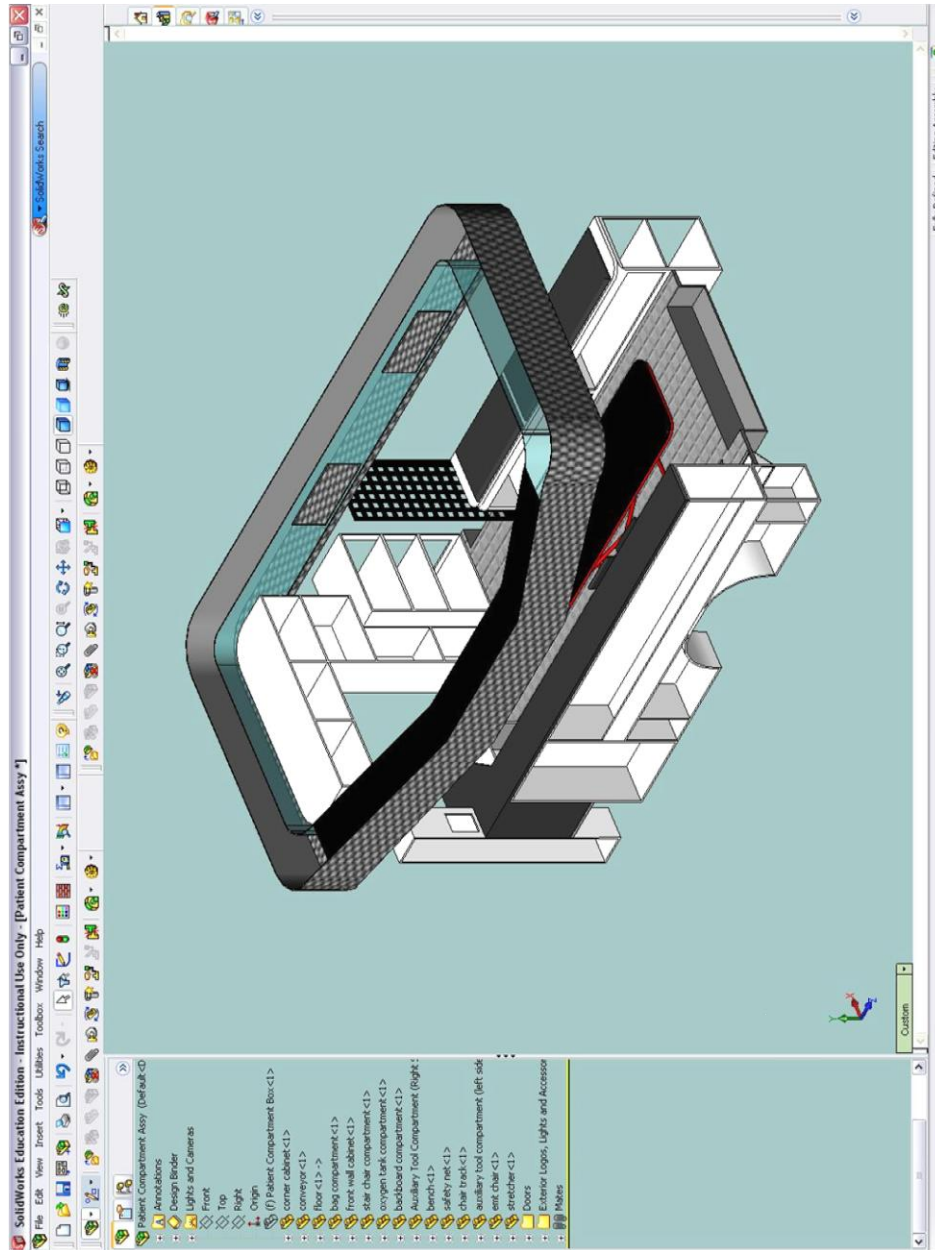
1. Skinner, Henry Alan. 1949, "The Origin of Medical Terms". Baltimore: Williams & Wilkins
2. How Products Are Made: Ambulance. Retrieved on 2008-04-20.
3. <http://www.civilwarhome.com/ambulancewagons.htm>
4. Origins of the Star of Life at Gorham EMS. Gorham EMS. Retrieved on 2008-04-20.
5. Questions and Answers. Ambulance Travel Trust. Retrieved on 2008-04-20.
6. Information on Quadtech EMS quad. Quadtech. Retrieved on 2008-04-20.
7. Kuehl, Alexander E. (Ed.). Prehospital Systems and Medical Oversight, 3rd edition. National Association of EMS Physicians. 2002. @ ch. 1.
8. Higginbotham, Peter (October 2005). The MAB Land Ambulance Service. Workhouses Information. Retrieved on 2008-04-20.
9. St John Ambulance First Aid Cover for Events. St John Ambulance UK. Retrieved on 2008-04-20.
10. McCall, Walter MP. 2002. "The American Ambulance", Iconograftix
11. Miller-Meteor History. Miller Meteor. Retrieved on 2008-04-20.
12. Medical Evacuation in the Korean War. olive-drab.com.
13. Ambulance Lifts. Ross and Bonnyman. Retrieved on 2008-04-20.
14. 2006 Ford E-Series Cutaway Chassis: Specifications. Ford. Retrieved on 2008-04-20.
15. 2006 Ford F-Series Super Duty Chassis Cab Ambulance: Specifications. Ford. Retrieved on 2008-04-20.
16. 2006 Ford E-Series Van Ambulance: Specifications. Ford. Retrieved on 2008-04-20.
17. US Government Careers advice on EMT. Retrieved on 2008-04-20.
18. <http://www.freepatentsonline.com/7066521-0-large.jpg>
19. <http://auto.howstuffworks.com/seatbelt3.htm>
20. <http://www.answers.com/topic/ambulance>

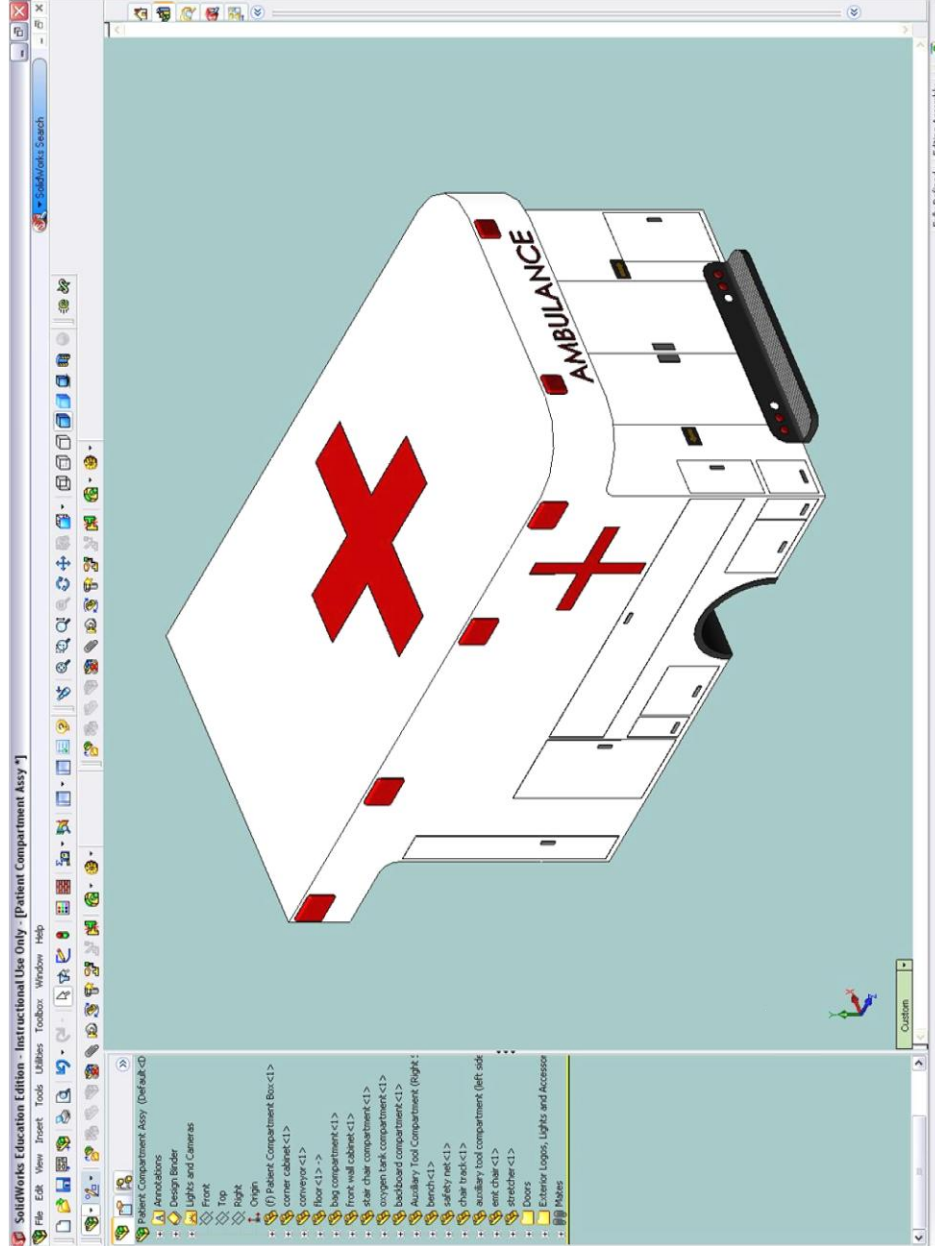


## **6. Appendices**











**Area Hatch/Fill**  
Adds a crosshatch pattern or solid fill to a model face or a closed sketch profile.

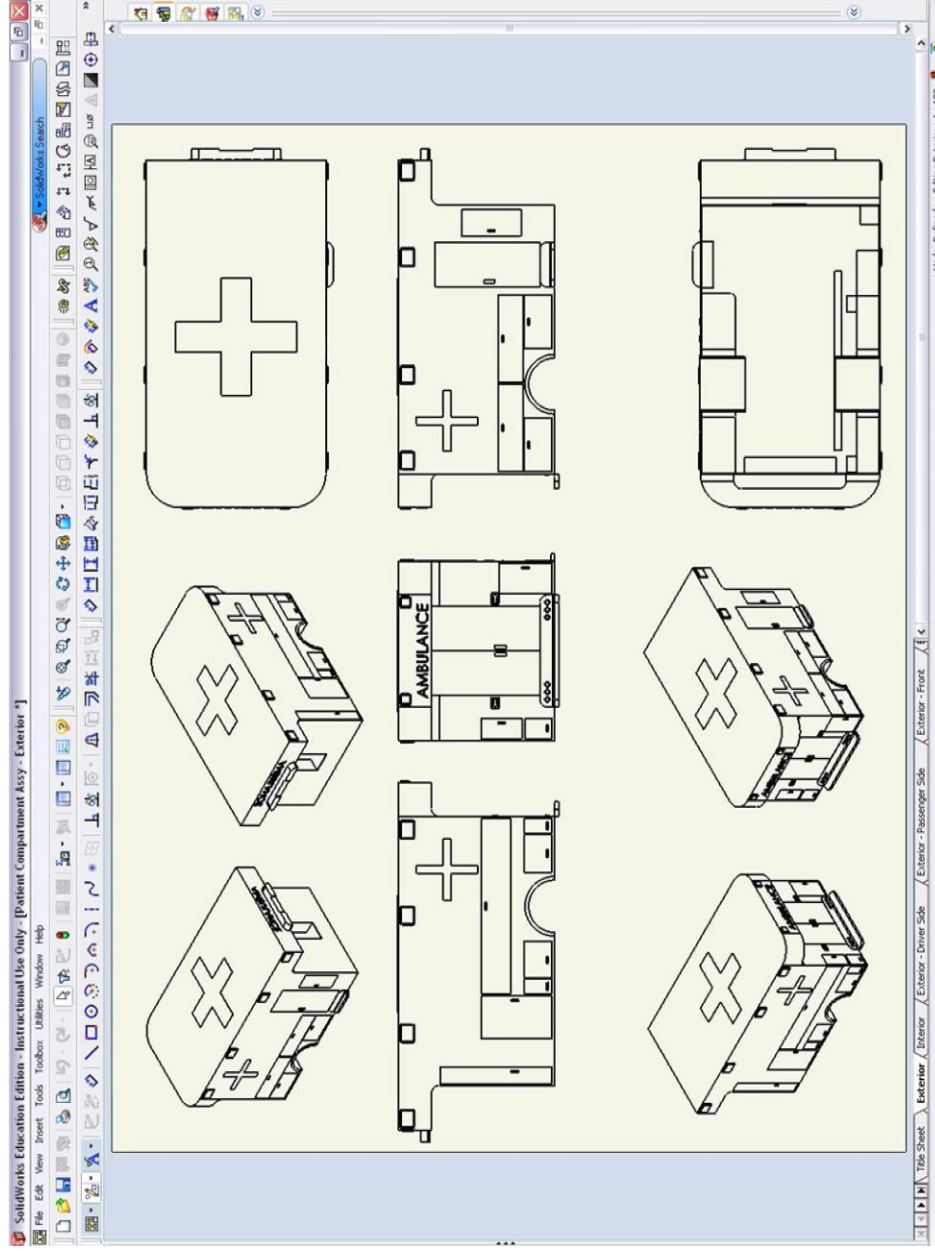


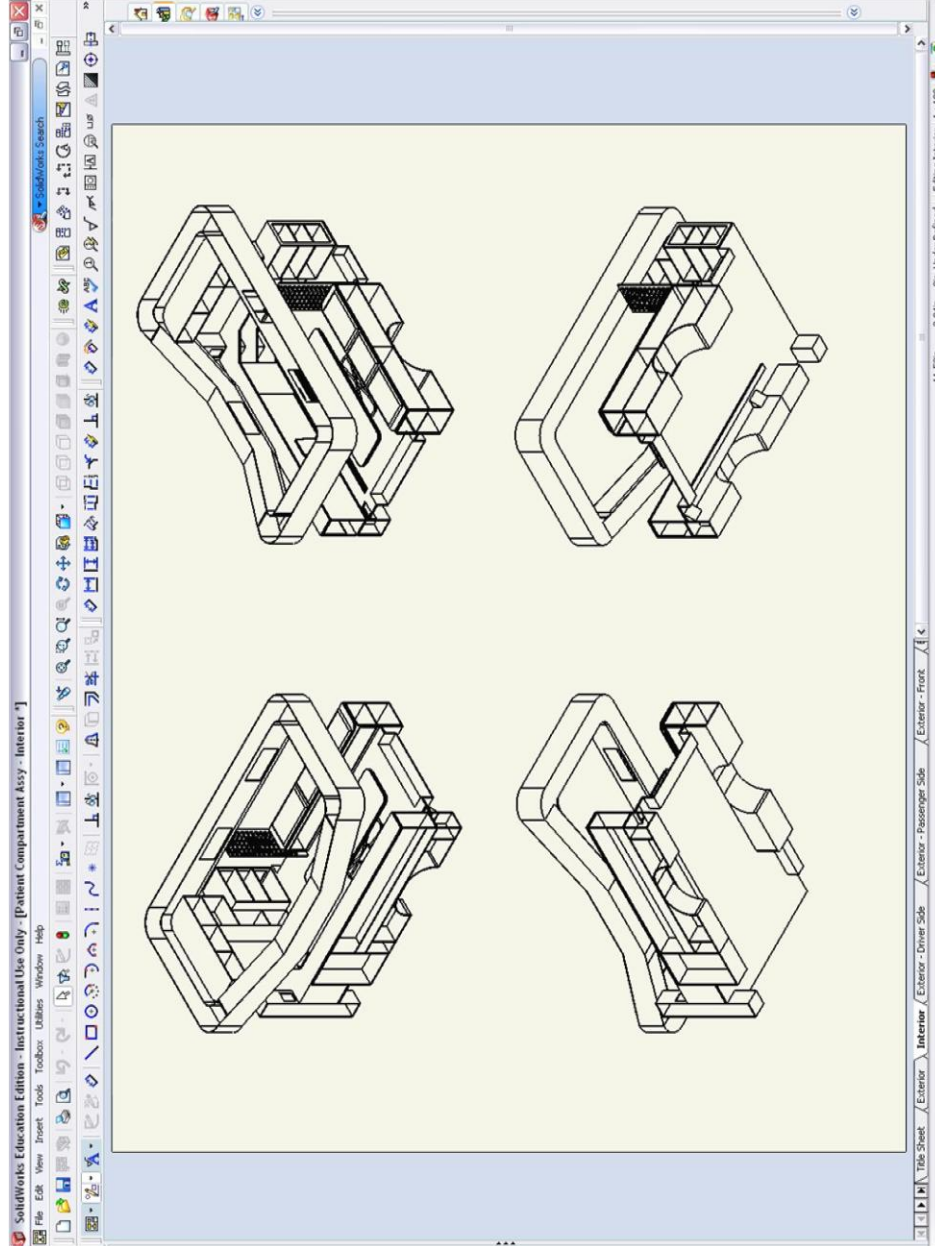
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Adds a crosshatch pattern or solid fill to a model face or a closed sketch profile.

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Adds a crosshatch pattern or solid fill to a model face or a closed sketch profile.

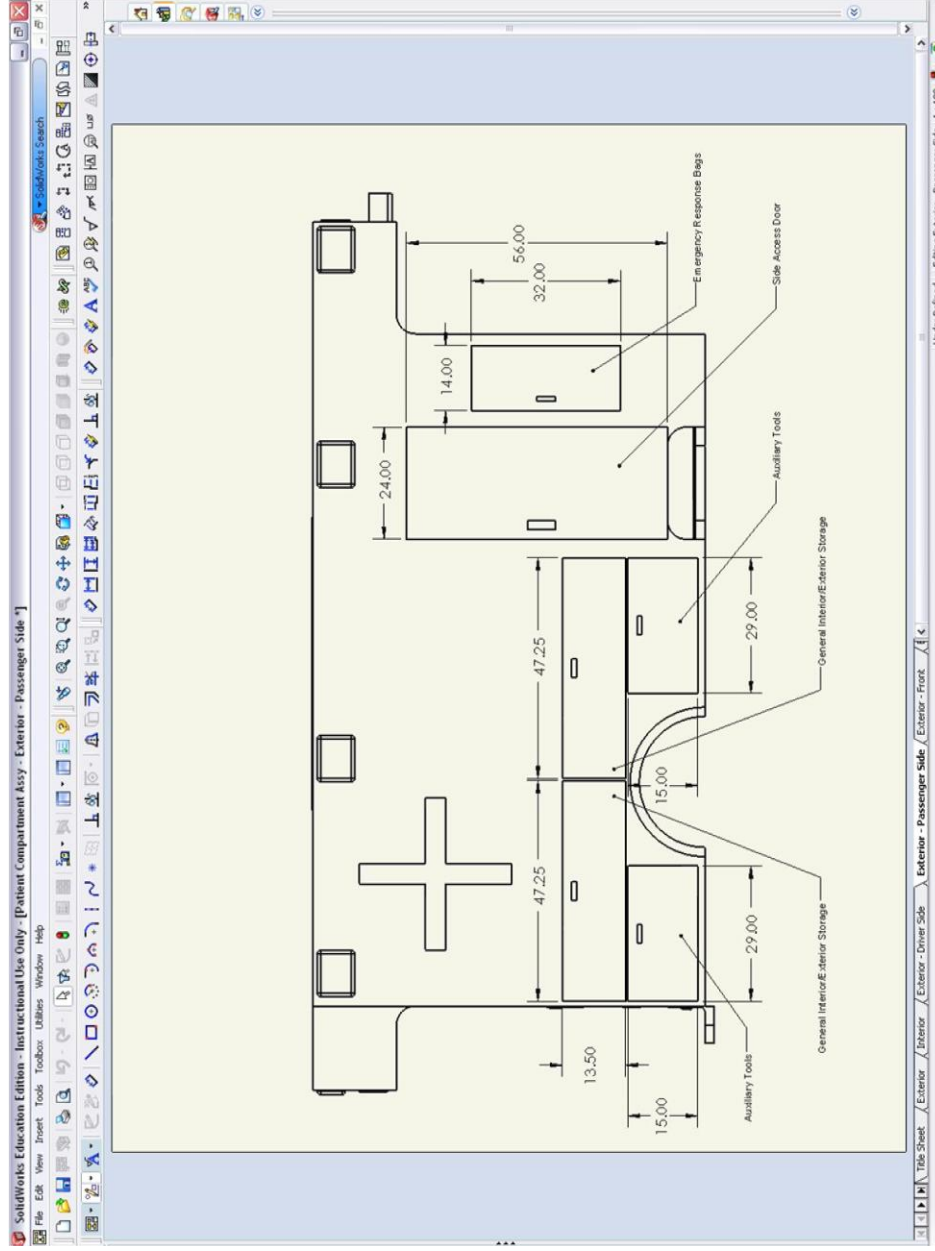
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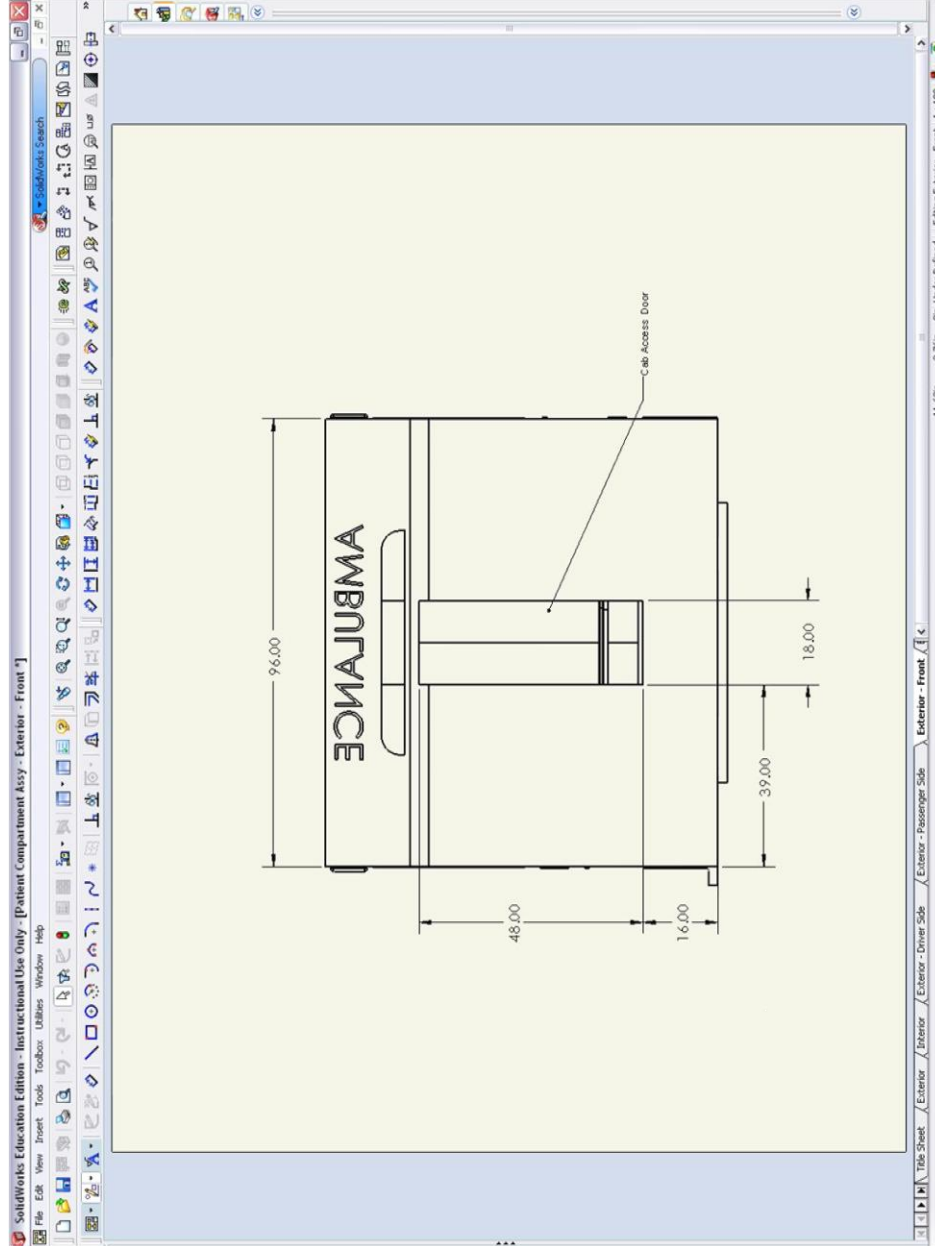
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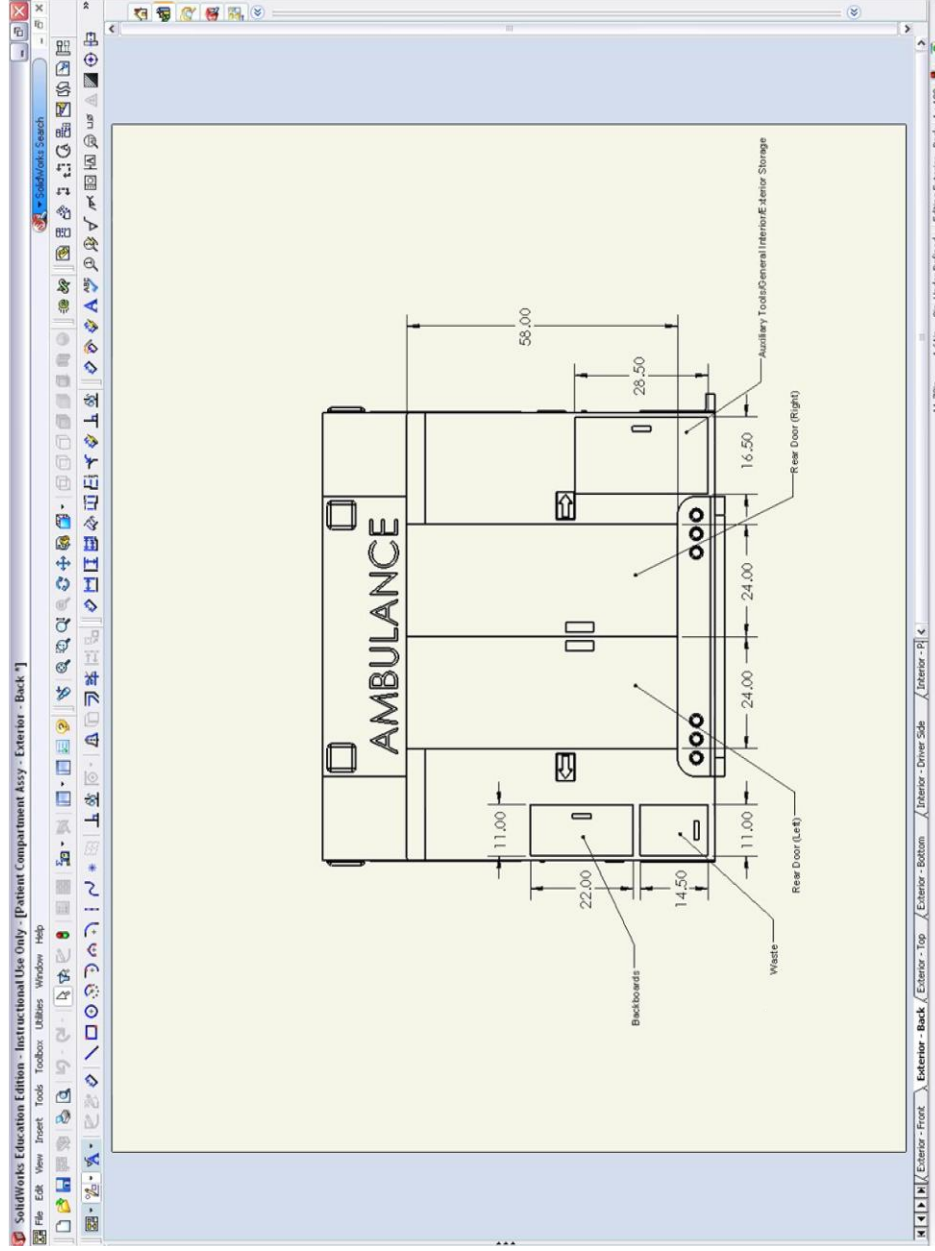


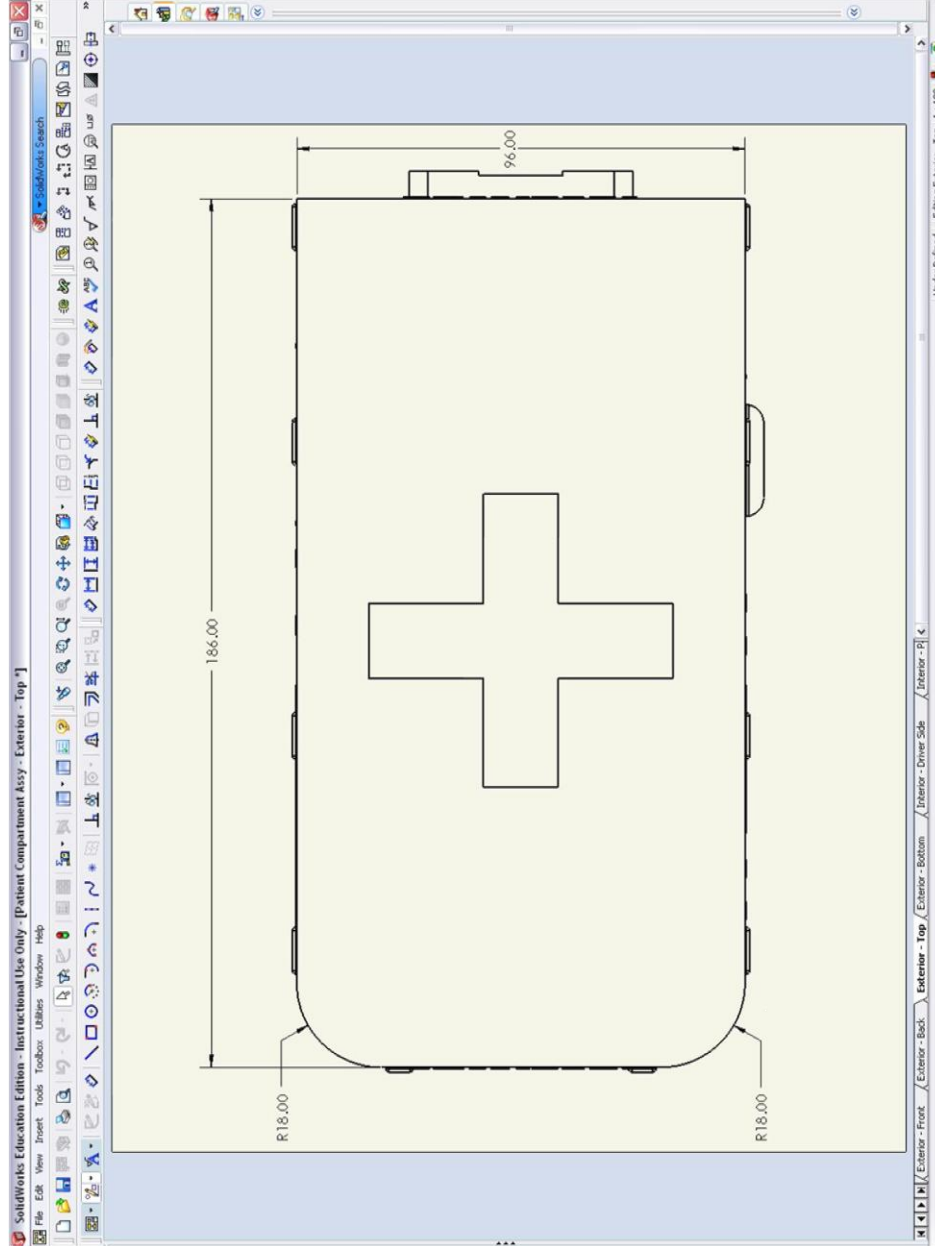




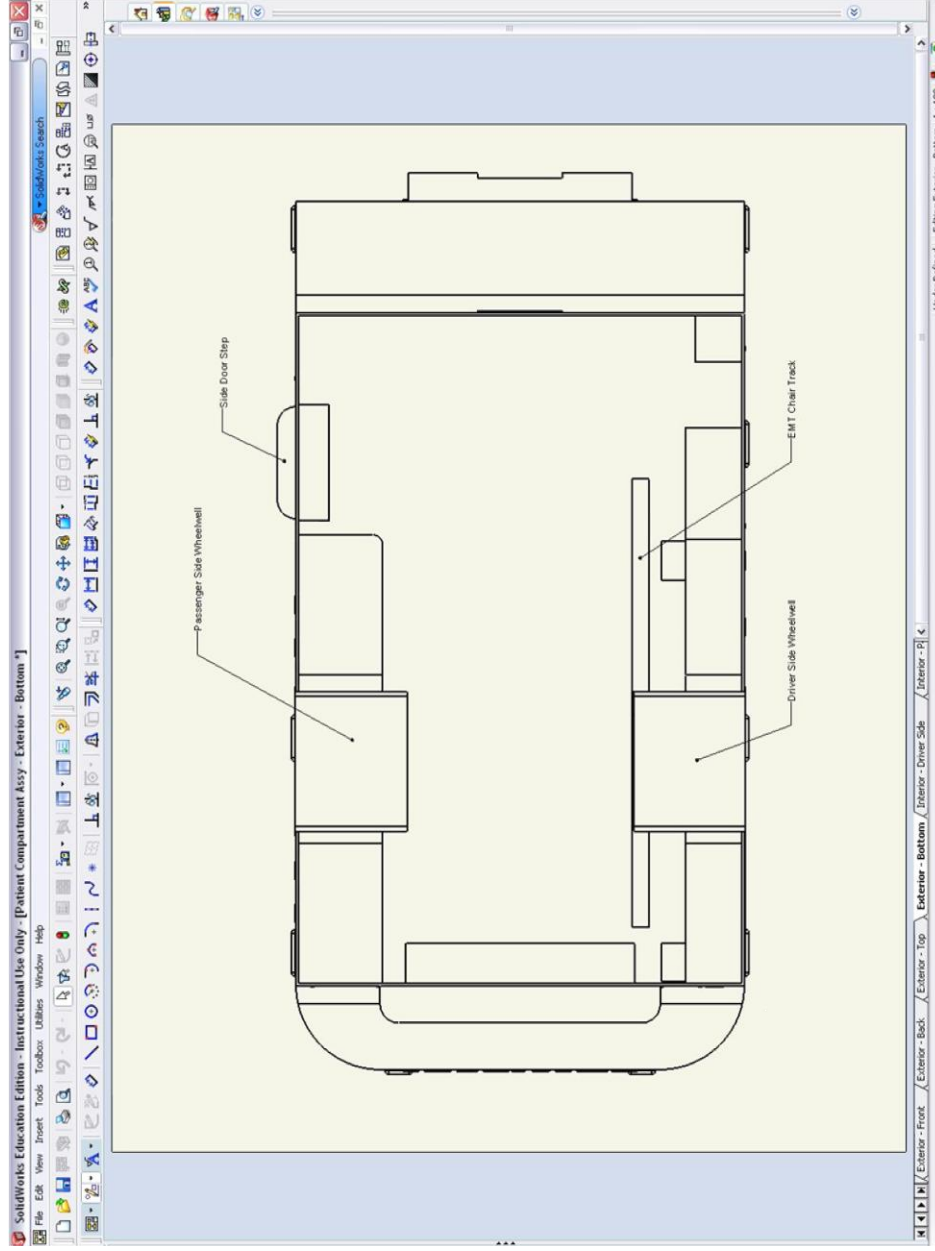


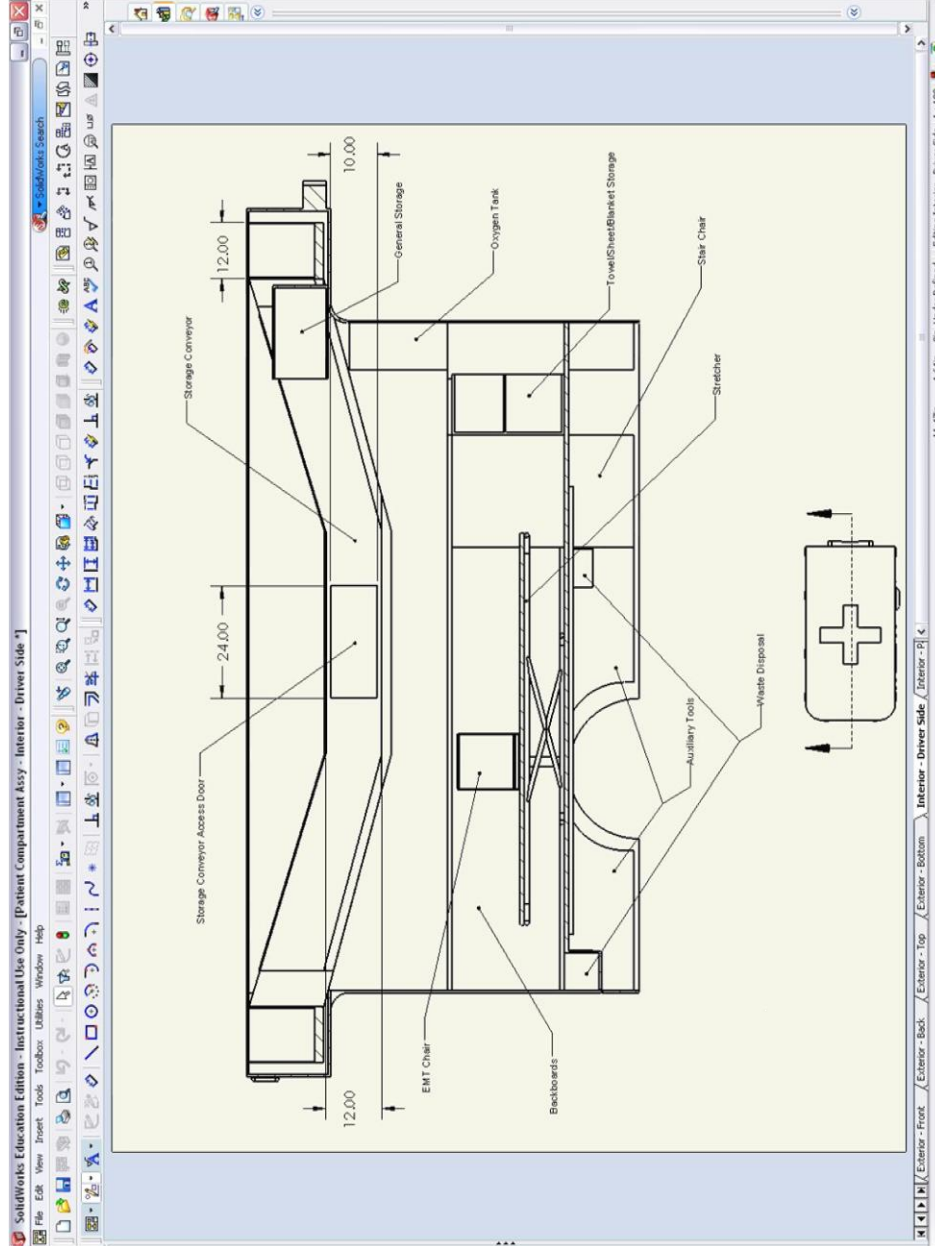


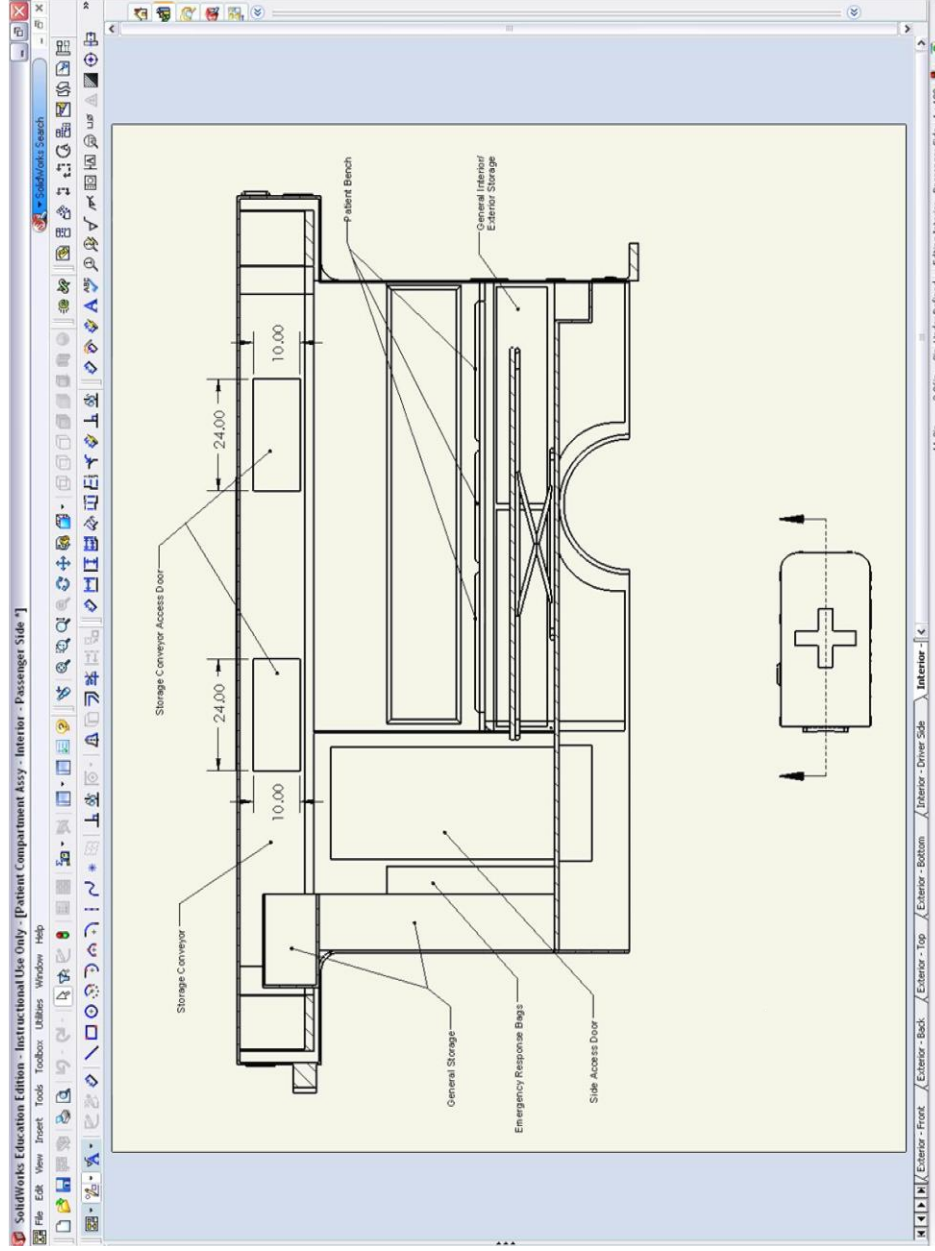


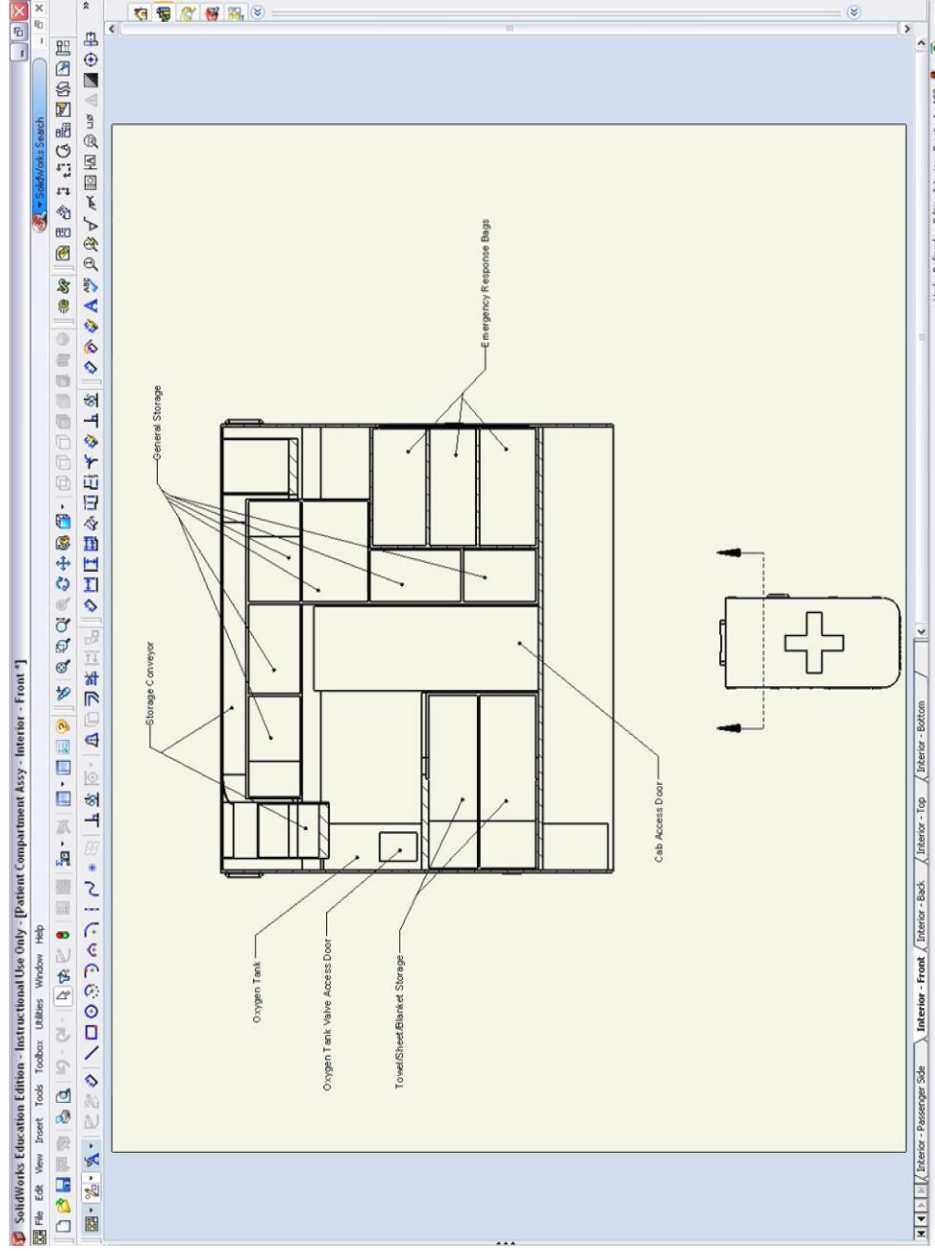


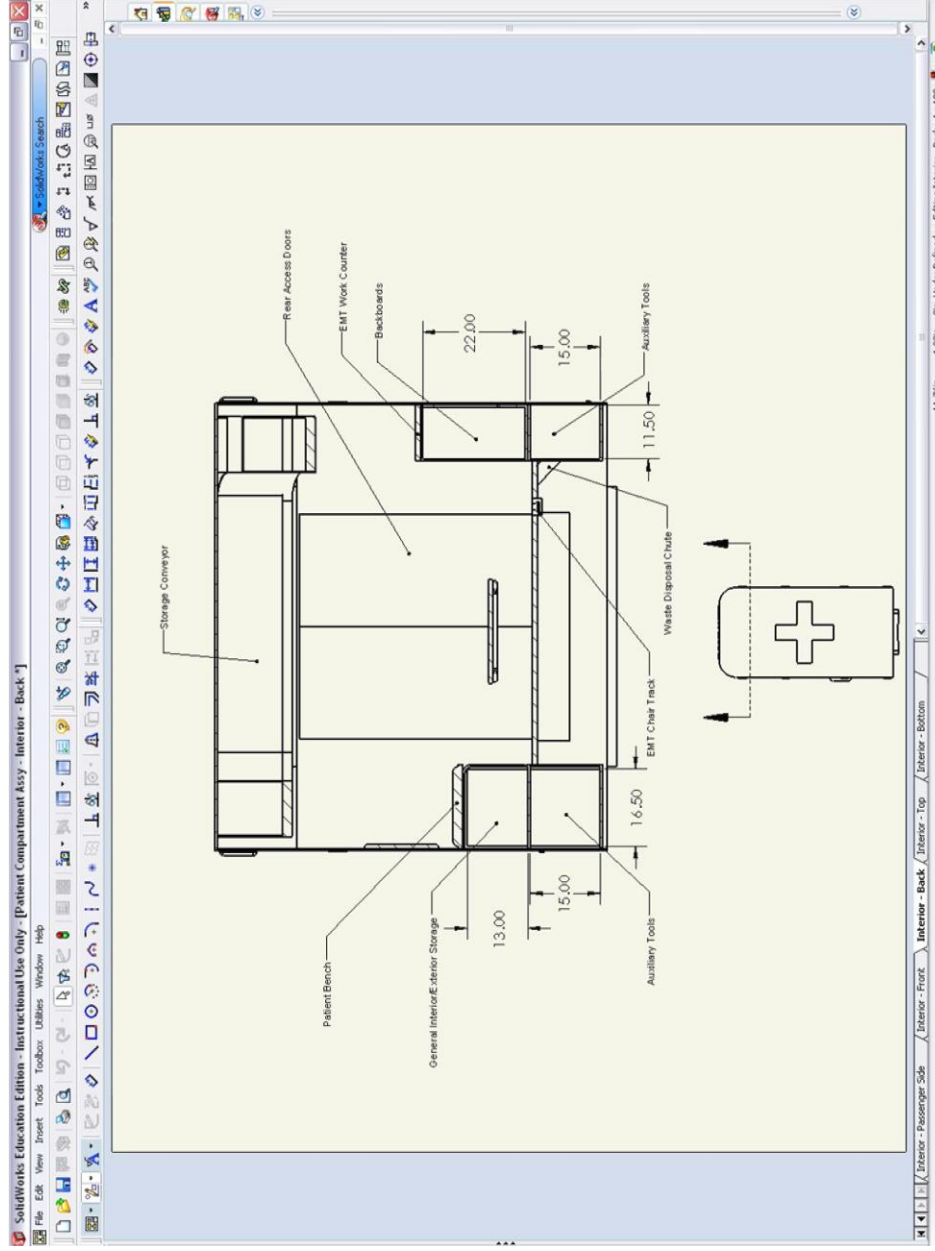


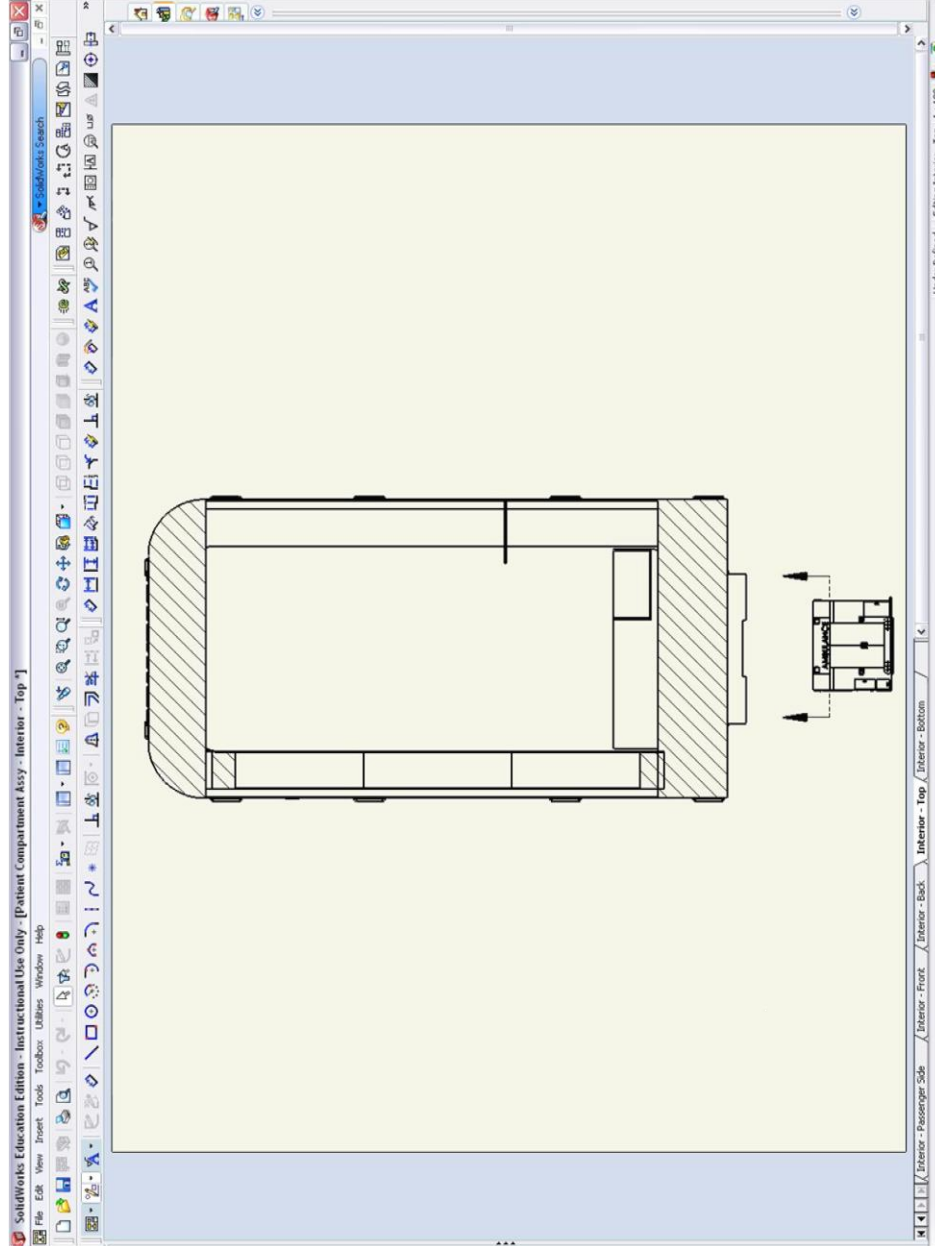


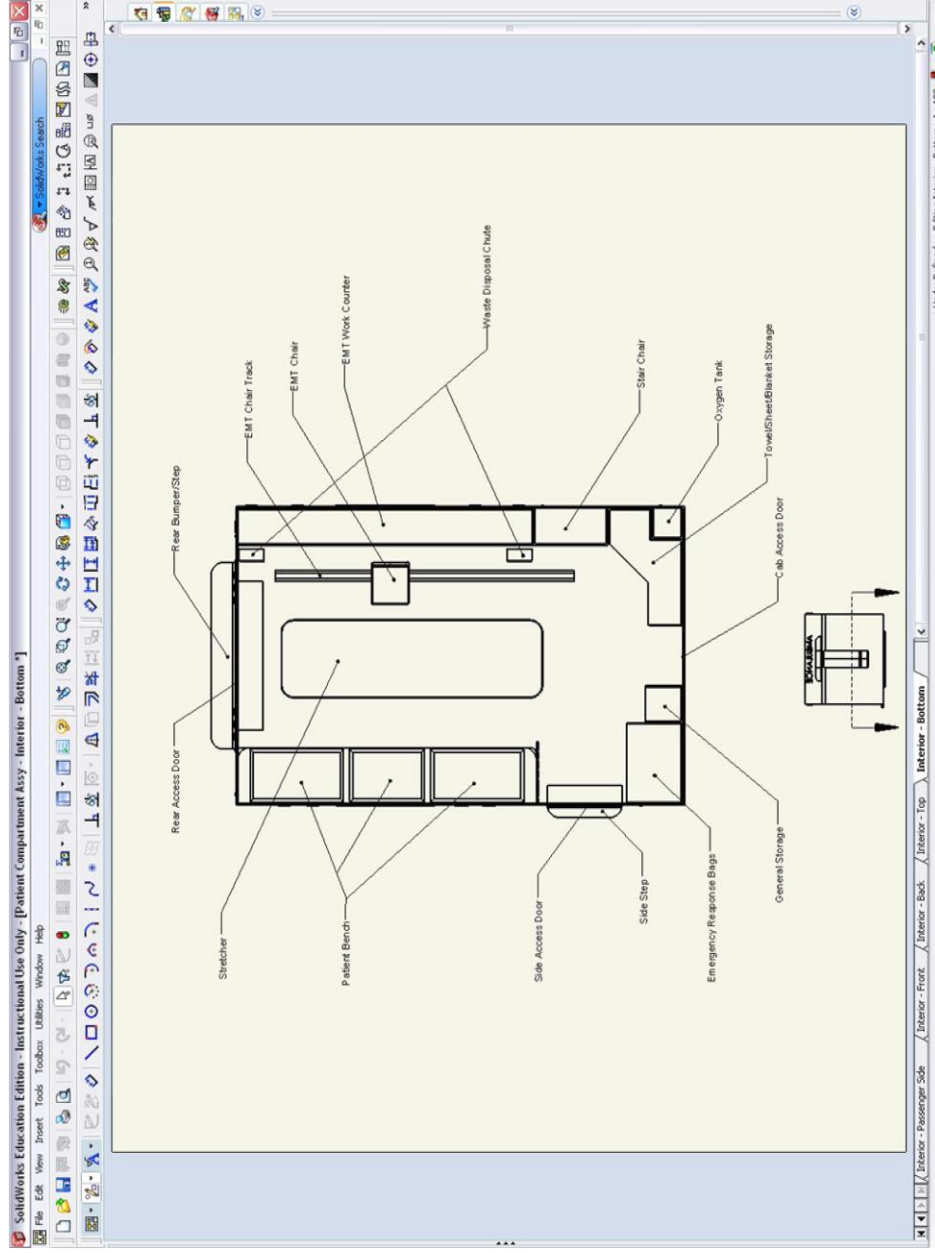












**To :**

**From :**

Demers Ambulances  
28, Richelieu  
Beloeil (Quebec) Canada  
J3G 4N5

Tel.:

Tel.: 1.800.363.7591

Fax :

Fax : 450.467.6526

**Subject :**

Type I Ambulance specifications  
(BLS configuration)

**Chassis :**

Ford F350 165" W/Base Chassis Cab 2005  
with Ambulance Package (4 x 4)

**Model :**

MYSTERE MXP144E-HD-05

**Interior trim :**

**Stock number :**

**Suggested price**

USD

**MYSTERE SPECIFICATION TOPICS**

**Equipment list:** • Standard ☐ *Optional* \* 2004 Novelty

<b>Group:</b>	▶ Driver's compartment	▶ Paint decals & lettering
	▶ Medical cabinet	▶ Patient compartment
	▶ Chassis	▶ Power distribution & control system
	▶ Oxygen	▶ Vehicle features
	▶ Ambulance module	▶ Emergency lights & sirens

**DRIVER'S COMPARTMENT**

1

- 1 • 12 V. DC Outlet, cigarette lighter type
- 2 • "Open door" & "Compartment" light ajar
- 3 • Anti-theft system
- 4 • Cab headliner with dome light - low and high intensity
- 5 • Coat hooks (2)
- 6 • Document case / Zip pack type (8038)
- 7 • Dual cup holder
- 8 • Fire extinguisher (5 lbs) ABC with heavy duty bracket (1)
- 9 • Hand spotlight 400 000 CD with trigger type switch
- 10 • High capacity air conditioning/heating
- 11 • HUC (Head up console) incorporated to dashboard, includes: gooseneck type light
- 12 • Tinted glass
- 13 • Trip odometer
- 14 • Wiring preparation for two-way radio with (2) antenna cables



## OPTIONS

		Unit price	Total price
15	<input type="checkbox"/> Reverse sensing system (2180, 5.5180, 10180)		
16	<input type="checkbox"/> CPC III electronic controlograph (note: requires computer software) (10013)		
17	<input type="checkbox"/> CPC III electronic controlograph and speed 2 (note: requires computer software) (10015)		
18	<input type="checkbox"/> Modify original door trays (12193)		
19	<input type="checkbox"/> Storage space for documents (delete std document case) (8137)		

## MEDICAL CABINET

2

- 20 • Aluminium frame with fibreglass compartments with lighting and (1) 115 V.AC outlet
- 22 • Exterior location for backboards /spine boards
- 24 • Shelf slider divider in cavities (8)
- 25 • Tinted polycarbonate window in cabinet

## CHASSIS

3

- 26 • Chassis
  - FORD F-350 Pick-up 2003
- 27 • Engine
  - 6.0L Diesel V8 Power Stroke
- 28 • Wheelbase
  - 165 in. (4190 mm)
- 29 • Transmission
  - Electronic 5-Speed Automatic O/D
- 30 • Audio
  - Electronic AM/FM/Cassette - stereo with clock
  - Includes 4 speakers
- 31 • GVWR
  - 12,500 Lbs / 5669 Kg (Gross vehicle weight rating)
- 32 • Ambulance Preparation Package (47A) - Summary -
  - Air Conditioning connector package
  - 4.10 limited slip axle ratio
  - Dual alternator : 220A total
  - Auxiliary idle control, limited fonction
  - Driver & Passenger air bag
  - Tilt steering wheel

## OPTIONS

Unit price      Total price

- 33 ☐ Dual cloth captain's chairs
- 34 ☐ Exterior upgrade package
- Front chrome bumper
  - Aerodynamic headlamps
- 35 ☐ Interior upgrade package
- Front cloth headliner
  - High series door trim panels
  - Cloth sunvisors
  - Power door lock/windows
  - Insulation package

- 37 ☐ Speed control

**Some options may differ in availability according to market**

## OXYGEN

4

- 38 • "D" OR "E" Oxygen cylinder brackets (2)
- 39 • Horizontal holders for main oxygen bottle type "K" to "M" on the floor between the driver and patient compartments
- 40 • Oxygen outlets (3) with flow meter (0-15LPM) : 1 at right on wall and 2 at left in ECC
- 41 • Oxygen regulator (50 PSI)

## MODULE

5

- 43 • All aluminium module (Certified to KKK-A-1822, QVM, FMVSS, CMVSS, AMD)
- 44 • Overall dimensions
- 144" [3658 mm] long x 89" [2260 mm] wide
  - Interior headroom 64"
- 45 • Module frame
- High strength aluminium sections
- 46 • Panels and structure
- Single piece sheet [Marine environment resistance]
  - Panel thickness of 0.090" [2.300 mm]
  - Wall structure : 0.090" [2.300 mm] high strength aluminium sections
- 47 • Assembly method
- Acid preparation on the exterior structures (enhance bonding)
  - High structural elastic adhesive assembly of the wall panels to the wall structure
  - Rivets assembly of the floor panel to the floor structure
- 48 • Left configuration
- 1 door midway for equipment access

- 49 • Right configuration
  - 1 door with window at midway for patient compartment access
  - 1 door at front for batteries and “M” oxygen cylinder access
  - 1 door at rear for backboards/spineboards
- 50 • Rear configuration
  - 2 doors with windows for patient loading
- 51 • Roof configuration
  - Single piece sheet continuously welded [Marine environment resistance]
  - Perimeter with built-in drip rail
- 52 • Floor configuration
  - Single piece sheet [Marine environment resistance]
  - Aluminium wheel well liner, thickness of 0.125” [3.175 mm]
  - Panel thickness of 0.060” [1.524 mm]
  - Step well : aluminium checker plate of 0.090” [2.300 mm]
- 53 • Doors configurations
  - Single piece sheet
  - Drip rail over all doors
  - Exterior panel thickness of 0.125” [3.175 mm]
  - Interior panel thickness of 0.090” [2.300 mm]
  - Door structure : 0.125 “ [3.175 mm] high strength aluminium sections
  - Door frame : high strength aluminium sections (enable dual gasket)
- 54 • 10 module to chassis rubber mount points
- 55 • Hardware
  - Door hold open device
  - Emergency door open device
  - Stainless steel piano hinges
  - Two (2) double stage rotary latches controlled through metal rods and “Trimark” black powder coat paddle handles.

#### OPTIONS

		Unit price	Total price
56	<input type="checkbox"/> Electric door lock on all module doors (5) (req. Door lock on chassis) (2, 5, 12084)		

#### PAINT DECALS AND LETTERING

6

- 57 • White exterior paint

#### OPTIONS

		Unit price	Total price
58	<input type="checkbox"/> Striping and identifications	Price on request	

## PATIENT COMPARTMENT

7

- 59 • ABS thermoplastic interior finish
- 60 • Action wall console (ECC)
  - Switches and commutators
  - Fluorescent lamp in ECC
  - Intercode lighting system with buzzer
  - Rear speaker volume control
  - Thermostat; (dual stage) for A/C and heater
- 61 • Air conditioning unit
- 62 • Bio hazard container on the forward of the squad bench
- 63 • Entry door areas with 3 chrome grab rails and 2 black grab handles
- 64 • Exhaust fans (2) for contaminated air
- 65 • Fire extinguisher (5 lbs) ABC with heavy duty bracket (1)
- 66 • Flooring: 5/8 in. (16mm) exterior grade plywood
- 67 • Glass : side (sliding) and rear (fixed) door privacy tinted
- 68 • Gooseneck light at the head of the primary patient
- 69 • Hand-rail on ceiling 63 in. (1600 mm)
- 70 • Head seat : thermoformed with safety belt and turning base (14100)
- 71 • Heating unit
- 72 • Insulation : thermal and acoustical
- 73 • IV hooks (2) ceiling recessed
- 74 • Locking compartment in medical cabinet
- 75 • Low and high intensity patient compartment fluorescent lights (4), low intensity patient compartment dome light (1) with 10 seconds delay shut off
- 76 • Partition with self latching sliding window only (8034, 9034)
- 77 • Radio speakers (2)
- 78 • Rolling cot fastener (STRYKER), cot not supplied
- 79 • Slip resistant, bacteriostatic and anti-static floor covering material .078 in. (2mm) thickness rolled-up 3 in. (75mm)
- 80 • Squad bench for 3 passengers, safety belts and thermoformed molded cushions to receive combination stretcher/chair
- 81 • Suction pump with collection bottle and uni-service bag
- 82 • Trash container at the bottom of the ECC
- 83 • Working lights (2) with 0-15 minutes timer



**DEMERS**  
AMBULANCES

28, Richelieu, Beloeil (Quebec) J3G 4N5

**MYSTERE**

16/11/2004

## OPTIONS

		Unit price	Total price
84	<input type="checkbox"/> Cardiac monitor tray, sliding and turning (11048)		
85	<input type="checkbox"/> Clock (battery powered) with light (9055)		
86	<input type="checkbox"/> Facial tissue box holder (Ship loose) (9143)		
87	<input type="checkbox"/> Hand-rail (18 in) (specified location _____) (9040)		
88	<input type="checkbox"/> Hand-rail (36 in) (specified location _____) (9097)		
89	<input type="checkbox"/> Head seat with two (2) armrests :thermoformed (Replace std head seat) (14099)		
90	<input type="checkbox"/> Head seat without armrest equipped with child safety device : thermoformed (Replace std head seat) (14227)		
91	<input type="checkbox"/> Intercom: telephone style (specified location) *** Right: _____ Left: _____ (right 5, 10019) (left 5, 10020)		
92	<input type="checkbox"/> Latex gloves box holder (ship loose) (9043)		
93	<input type="checkbox"/> Needle container (9101)		
94	<input type="checkbox"/> Safety net at front end of the squad bench (11, 13050)		
95	<input type="checkbox"/> Self latching sliding door on partition (8035, 9035)		

## POWER DISTRIBUTION AND CONTROL SYSTEM

8

- 98 • Alternators (2) of 110 amps each
- 99 • Batteries (4) : (2) OEM, (2) auxiliary (4,518)
- 100 • Electrical outlets (2) 12 V. DC, cigarette lighter type : (2) at patient head
- 101 • Shoreline with (2), 115V A/C interior outlets (2, 6007)

## OPTIONS

		Unit price	Total price
102	<input type="checkbox"/> Auto-eject shoreline (replace standard shoreline) (2, 6005)		
103	<input type="checkbox"/> Isolator & battery switch for auxiliary batteries (4, 5217)		
104	<input type="checkbox"/> Power inverter ( 12 V.DC to 115 V.AC,1000 Watt) also includes cigarette lighter plug (10 AMPS) in the first aid kit storage (4, 7, 10, 13011)		
105	<input type="checkbox"/> Power inverter (Supplied by others) ( 12 V.DC to 115 V.AC,1000 Watt) also includes cigarette lighter plug (10 AMPS) in the first aid kit storage (4, 7, 10, 13012)		

## VEHICLE FEATURES

9

- 106 • Anti-skid lateral steps angle to match module width includes: mud guards
- 107 • Convex mirrors (2) (12234)
- 108 • Directional and gabarit lights (L.E.D.)
- 109 • High mount rear brake light (10131)
- 110 • Rear retractable anti-skid step
- 111 • Reinforced rear door-open device
- 112 • Turning lights (2) intermediate side mounted
- 113 • Undercoating protection
- 114 • Under frame spare tire location

## OPTIONS

		Unit price	Total price
116	<input type="checkbox"/> Aluminium rub-rail (1190)		
117	<input type="checkbox"/> Emergency flare case (8036)		
118	<input type="checkbox"/> High mount rear break light (L.E.D) (delete std break light) (10126)		
118	<input type="checkbox"/> Remote and heated "VELVAC" exterior mirrors with timer (delete std mirrors) (5, 6104, 12104)		
118	<input type="checkbox"/> Stainless steel wheel simulators (14071)		
119	<input type="checkbox"/> Tow hooks (2) at rear (1003)		
120	<input type="checkbox"/> Ultra sound whistle for animals (one on each side) (9044)		

## EMERGENCY LIGHTS & SIREN

10

- 121 • Back up alarm (97db) with override switch
- 122 • Intersection red halogen lights (2) mounted in angled aluminium bezels (6107)
- 123 • Lateral scene lights (2) on each side : total of (4)
- 124 • Light bar, flush mount with 2 red and 1 clear (central) halogen flashing lights and 4 red rotating lights.
  - Module : 6 red halogen flashing lights (2, 5, 6, 8, 10158)
  - Fibreglass moulded grille (white) includes: halogen red lights (2) and 100 watt speakers (2)
- 125 • Rear amber halogen lights (2)
- 126 • Rear amber halogen turning arrows (2) at middle height (10089)
- 127 • Rear loading halogen lights (2)
- 128 • Siren amplifiers (100 watt) with 4 tones and Public address (P/A) microphone
- 129 • Wig Wag headlamps

**\*\* 2004 models comes std with "WHELEN" products.**

## OPTIONS

		Unit price	Total price
130	<input type="checkbox"/> Amber halogen fog lights with covers (6032)		
131	<input type="checkbox"/> Clear halogen fog lights with covers (6033)		
132	<input type="checkbox"/> Front L.E.D red lights (2) on front valance and 2 additional rear L.E.D. lights (2, 6, 10225) at windows height (N/A with 2, 10088)		
133	<input type="checkbox"/> Intersection red halogen lights with clear halogen turning lights (Delete STD intersection lights) (6106)		
134	<input type="checkbox"/> Intersection red strobe lights (2) mounted in angled aluminium bezels (5, 6214) (Delete STD intersection lights) (N/A with 2, 3, 5, 6, 8, 10157 and 2, 5, 6, 8, 10158)		
135	<input type="checkbox"/> Rear amber L.E.D. lights turning arrows (2) at middle height (Delete std turning arrows) (10125)		
136	<input type="checkbox"/> Rear red halogen lights (2) additional at windows height (2, 10088) (N/A with 2, 6, 10225 and 2, 5, 6, 8, 10154)		

## OPTIONS - EMERGENCY LIGHTING PACKAGE

- 137 ☐ Aerodynamic cabin roof with 4 red and 1 clear (central) with clear lens flashing lights.  
Module : 6 red halogen flashing lights and fibreglass moulded grille (white) includes:  
halogen red lights (2) and 100 watt speakers (2) (2, 3, 5, 6, 8, 10157)
- 138 ☐ Light bar, flush mount with 4 red rotating lights, 2 red, 1 clear (central) strobe lights.  
Module : 6 red strobe lights and fibreglass moulded grille (white) includes:  
red strobe lights (2) and 100 watt speakers (2) (2, 5, 6, 8, 10154)

## COMMENTS OR SPECIAL NOTES

- 139 ☐
- 140 ☐
- 141 ☐

**FREIGHT (to be evaluated case by case)**

**TOTAL** *USD*

**DISCOUNT**

**NET COST (Taxes not included)** *USD*

**Net Cost**  
**USD**

This bid is prepared according to your specifications and will become an integral part of your contract.

Also, the buyer acknowledge that by accepting this bid, he commits to take possession of the vehicle according to the delivery agreement between himself and Paul Demers & Fils inc.

All sales are payable upon delivery by certified cheque, bank transfer and or by financing contract prepared and signed on delivery date.

**Estimated delivery date :**

#	0
<i>Demers Ambulances</i>	0

The parties acknowledge that the Employee, in performing his duties, is solely acting as an employee of Demers Ambulances and is not authorised to assume any liabilities, duties or obligations, enter into any transaction in the name of Demers Ambulances nor bind Demers Ambulances. Any and all transaction to entered into on behalf of Demers Ambulances shall be authorised by a director, officer or any other representative of Demers Ambulances at the head office of Demers Ambulances situated in Beloeil, province of Quebec, Canada.

*Yves Demers*  
*Demers Ambulances*

*Date of the final approbation*  
*Corporate Headquarters - (Beloeil) Canada*

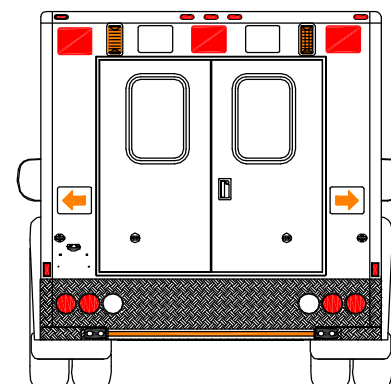
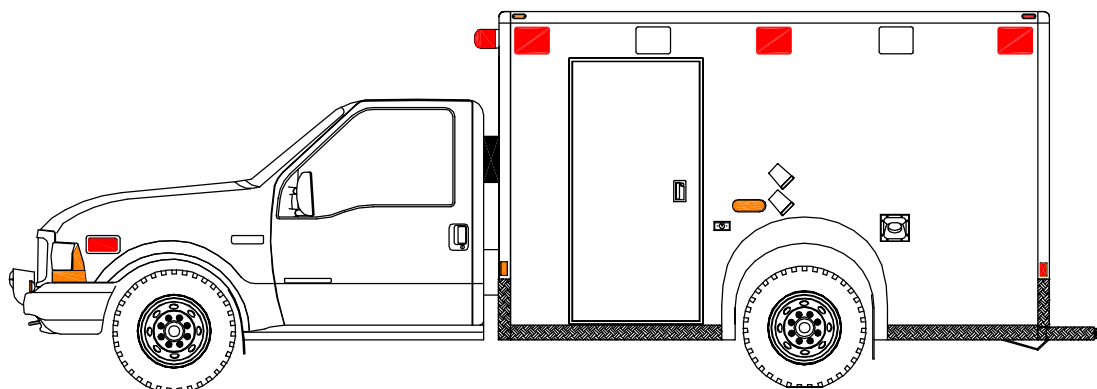
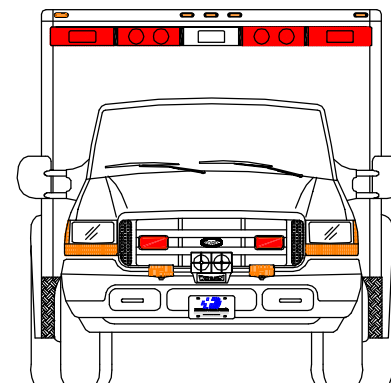
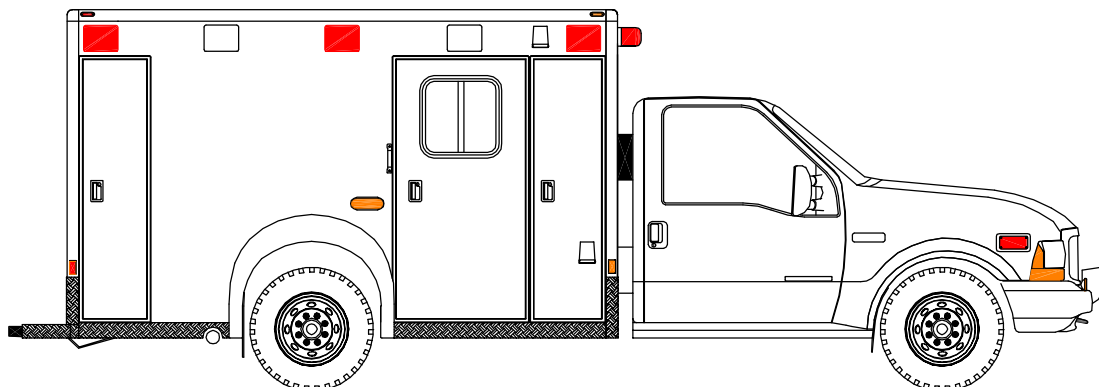



## CUSTOMER SPECIAL REQUIREMENTS FORM

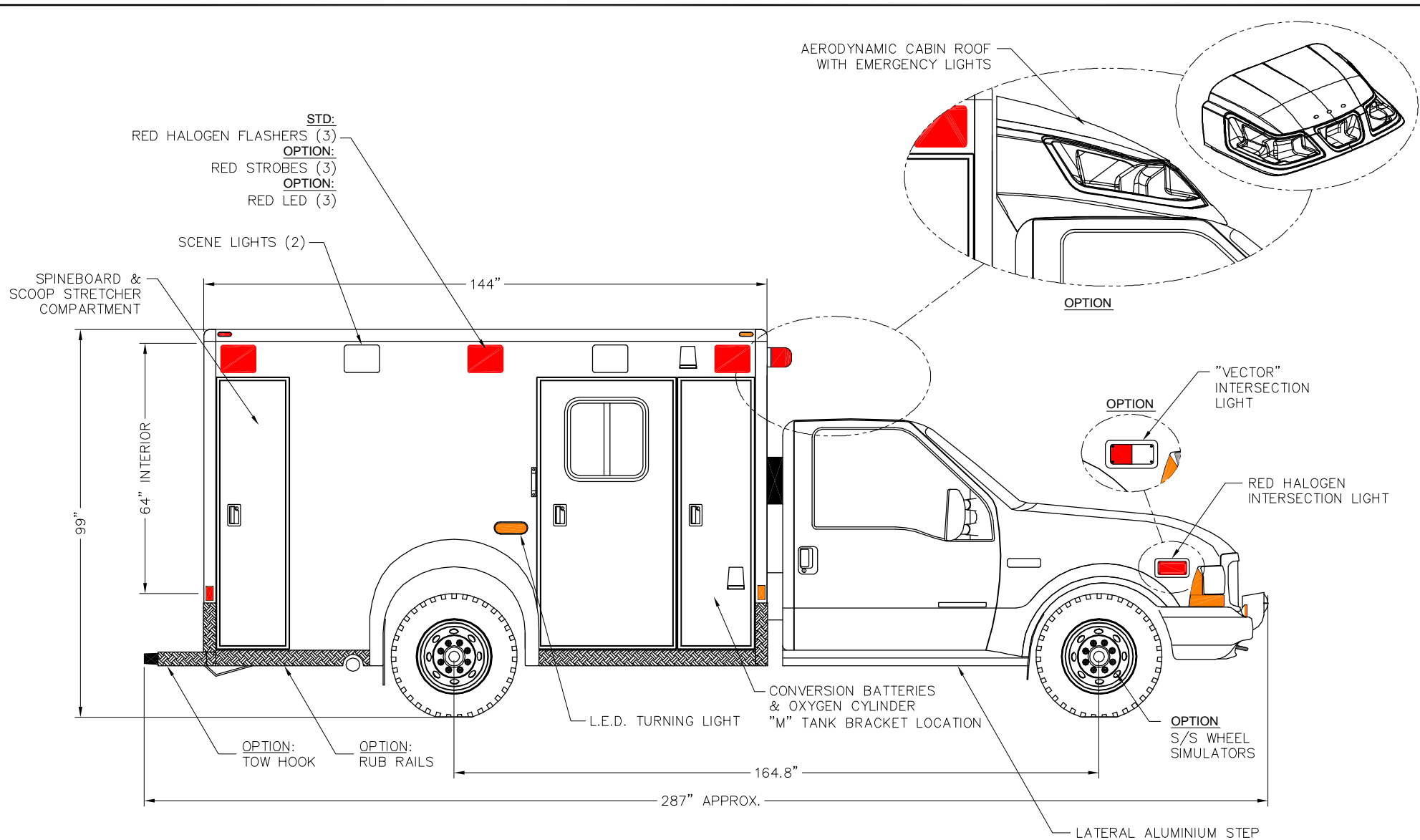
Description	Article	Initials
<input checked="" type="checkbox"/> <b>Outside rearview mirrors</b> We do not require that the hardware and mirror heads be chromed, polished stainless steel, or polished aluminium.	3.9.5	_____
<input checked="" type="checkbox"/> <b>Body Accomodations</b> We require that the ambulance can accomodate and store only the stretchers, cots and litters of style 1,2 and 3.	3.10.1	_____
<input checked="" type="checkbox"/> <b>Interior Storage Accomodations</b> <b>- Trash receptacle compartment and sharps disposal container</b> We do not require that the portable oxygen unit compartment meets the minimum volume recommended.	3.11.1	_____
<input type="checkbox"/> <b>Intercom System</b> We require a telephone style intercom system and are aware that the system does not meet KKK specifications.	3.14.5	_____
<input type="checkbox"/> <b>Medical, Surgical, and Biomedical Equipment</b> <b>- Electric Clock</b> We require that the electrical clock be battery powered instead of 12V DC chassis powered.	3.15.4 (M3)	_____
<input type="checkbox"/> <b>Emblems &amp; Markings</b> We require the ambulance to be painted matching the chassis color with no stripping, no emblems and no markings.	3.16.2 3.16.4	_____

**Note : Customer Special Requirements form shall take precedence on the manufacture's standards, options and KKK-A-1822-E specification.**

# DES. / DWG	REV	DESCRIPTION	VUE / VIEW	CLIENT
12FD-F350XXX-B3-0020	0	F-350 TYPE I AMBULANCE	GENERAL EXTERIOR	MYSTÈRE MXP144E
12FD-F350XXX-B3-0021	0	F-350 TYPE I AMBULANCE	RIGHT EXTERIOR	MYSTÈRE MXP144E
12FD-F350XXX-B3-0022	0	F-350 TYPE I AMBULANCE	LEFT EXTERIOR	MYSTÈRE MXP144E
12FD-F350XXX-B3-0023	0	F-350 TYPE I AMBULANCE	FRONT FACE	MYSTÈRE MXP144E
12FD-F350XXX-B3-0024	0	F-350 TYPE I AMBULANCE	REAR END	MYSTÈRE MXP144E
12FD-F350XXX-B3-0025	0	F-350 TYPE I AMBULANCE	RIGHT WALL - SINGLE MAIN COT CONFIGURATION	MYSTÈRE MXP144E
12FD-F350XXX-B3-0027	0	F-350 TYPE I AMBULANCE	LEFT WALL STANDARD CABINETRY	MYSTÈRE MXP144E
12FD-F350XXX-B3-0028	0	F-350 TYPE I AMBULANCE	FRONT WALL - SINGLE MAIN COT CONFIGURATION	MYSTÈRE MXP144E
12FD-F350XXX-B3-0030	0	F-350 TYPE I AMBULANCE	REAR WALL - SINGLE MAIN COT CONFIGURATION	MYSTÈRE MXP144E
12FD-F350XXX-B3-0032	0	F-350 TYPE I AMBULANCE	FLOOR VIEW - SINGLE MAIN COT CONFIGURATION	MYSTÈRE MXP144E
12FD-F350XXX-B3-0034	0	F-350 TYPE I AMBULANCE	INTERIOR LIGHTS LOCATION	MYSTÈRE MXP144E
12FD-F350XXX-B3-0035	0	F-350 TYPE I AMBULANCE	FRONT CONSOLE	MYSTÈRE MXP144E
12FD-F350XXX-B3-0036	0	F-350 TYPE I AMBULANCE	REAR CONSOLE	MYSTÈRE MXP144E
Z0000198	1	E-350 TYPE III AMBULANCE	LIGHTS PATTERN	MYSTÈRE MXP144E



	DESCRIPTION : TYPE I – GENERAL EXTERIOR				# DESSIN / DRAWING NO.	
	CONTRAT/CONTRACT : MYSTÈRE MXP144E	CHASSIS/FRAME FORD	MODELE/MODEL F-350	DESS./DRAW. : C. ZBINDEN	12FD-F350XXX-B3-0020	
		ECH./SCALE 1:50	PAGE 1 / 1	VENT./SALES : D.R. / D.M.	REV.: 0	DATE: 18/02/03
				INGEN./ENGIN. : SYLVAIN DEMERS	# BOITE : B800606	



NOTES: 1-DRAWING MAY SHOW SOME OPTIONS  
2-ELECTRIC DOOR LOCK ON ALL MODULE DOORS IN OPTION

DESCRIPTION : TYPE I – RIGHT EXTERIOR

CONTRAT/CONTRACT :

MYSTÈRE  
MXP144E

CHASSIS/FRAME  
FORD

ECH./SCALE  
1: 35

MODELE/MODEL  
F-350

PAGE  
1 / 1

DESS./DRAW. :  
C. ZBINDEN

VENT./SALES :  
D.R. / D.M.

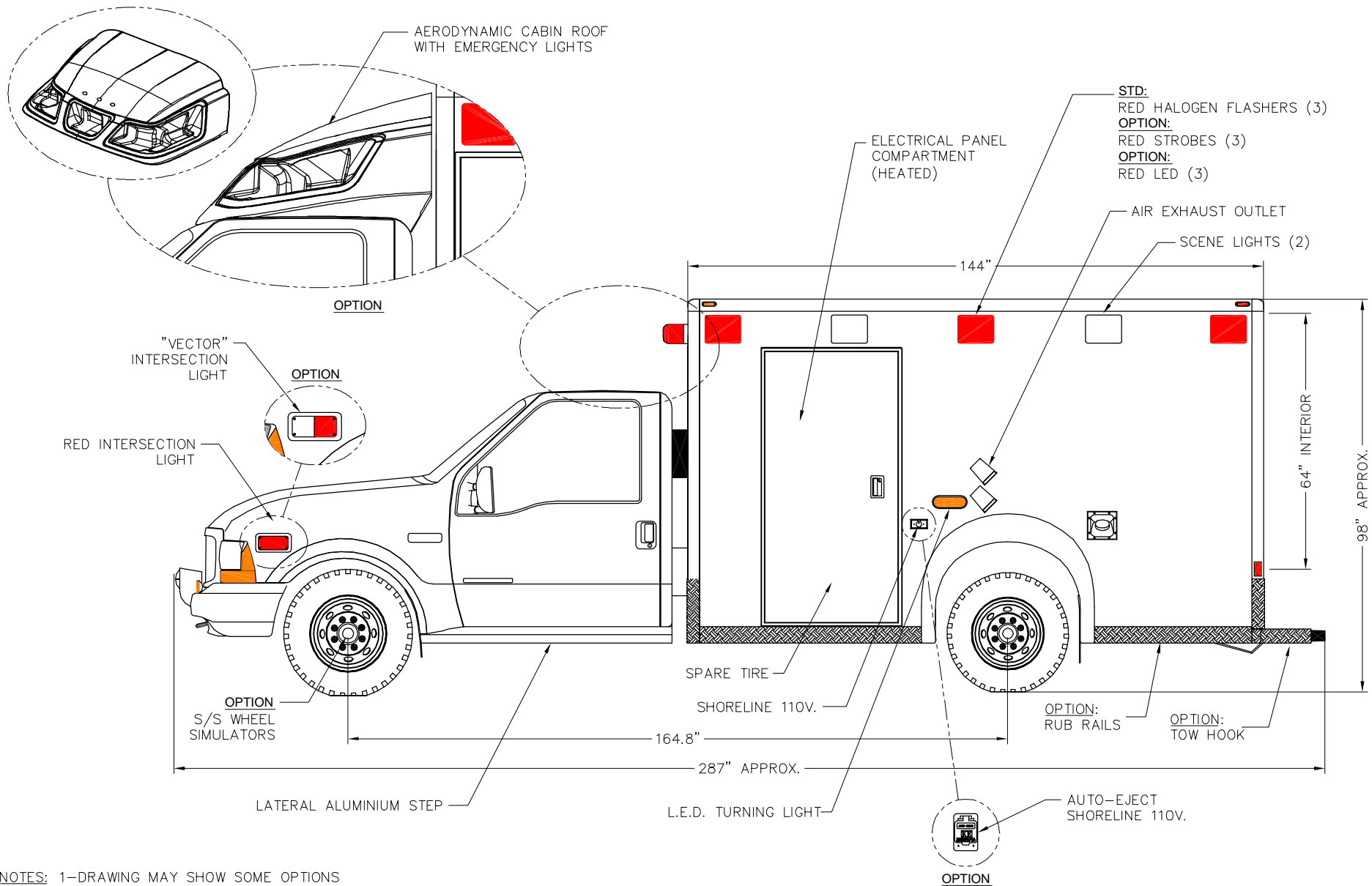
INGEN./ENGIN. :  
SYLVAIN DEMERS

# DESSIN / DRAWING NO.

12FD-F350XXX-B3-0021

REV.: 0 DATE: 18/02/03

# BOITE : B800606



DESCRIPTION : TYPE I – LEFT EXTERIOR

CONTRAT/CONTRACT :

MYSTÈRE  
MXP144E

CHASSIS/FRAME  
FORD

ECH./SCALE  
1: 35

MODELE/MODEL  
F-350

PAGE  
1 / 1

DESS./DRAW. :  
C. ZBINDEN

VENT./SALES :  
D.R. / D.M.

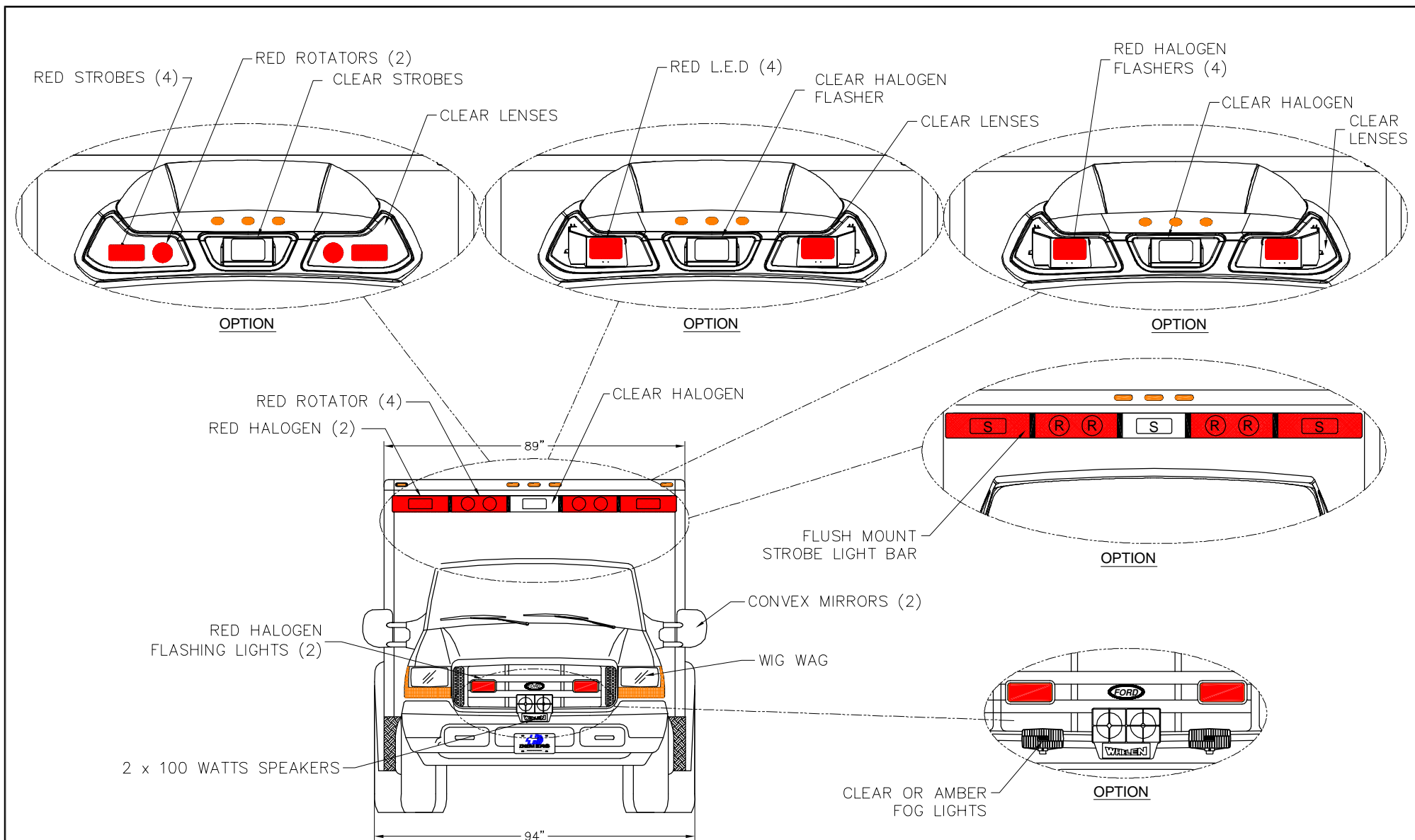
INGEN./ENGIN. :  
SYLVAIN DEMERS

# DESSIN / DRAWING NO.

12FD-F350XXX-B3-0022

REV.: 0 DATE: 19/02/03

# BOITE : B800606



NOTES: 1-DRAWING MAY SHOW SOME OPTIONS  
2-ELECTRIC DOOR LOCK ON ALL MODULE DOORS IN OPTION

DESCRIPTION : TYPE I – FRONT FACE

CONTRAT/CONTRACT :

MYSTÈRE  
MXP144E

CHASSIS/FRAME  
FORD

ECH./SCALE  
1: 40

MODELE/MODEL  
F-350

PAGE  
1 / 1

DESS./DRAW. :  
C. ZBINDEN

VENT./SALES :  
D.R. / D.M.

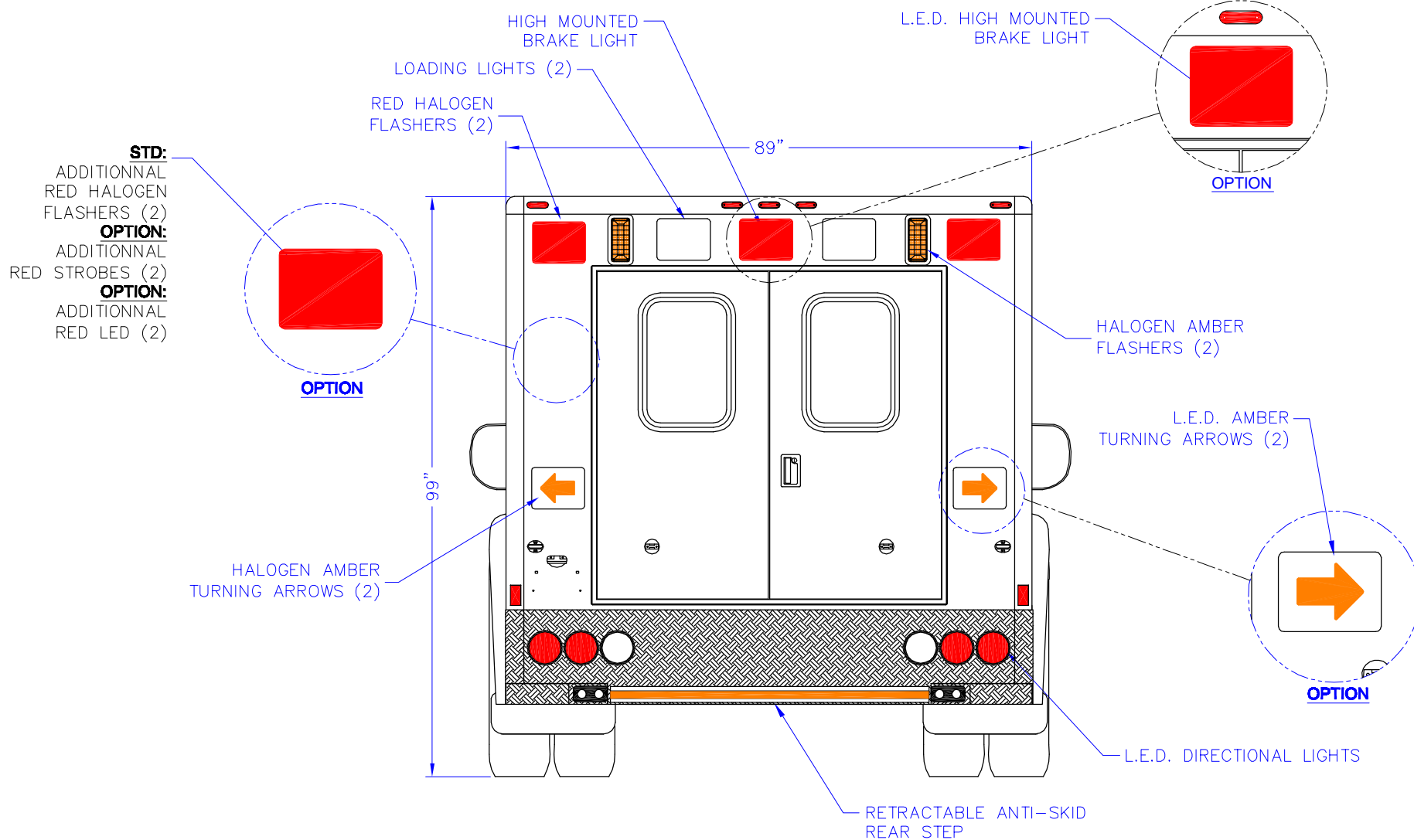
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SYLVAIN DEMERS

# DESSIN / DRAWING NO.

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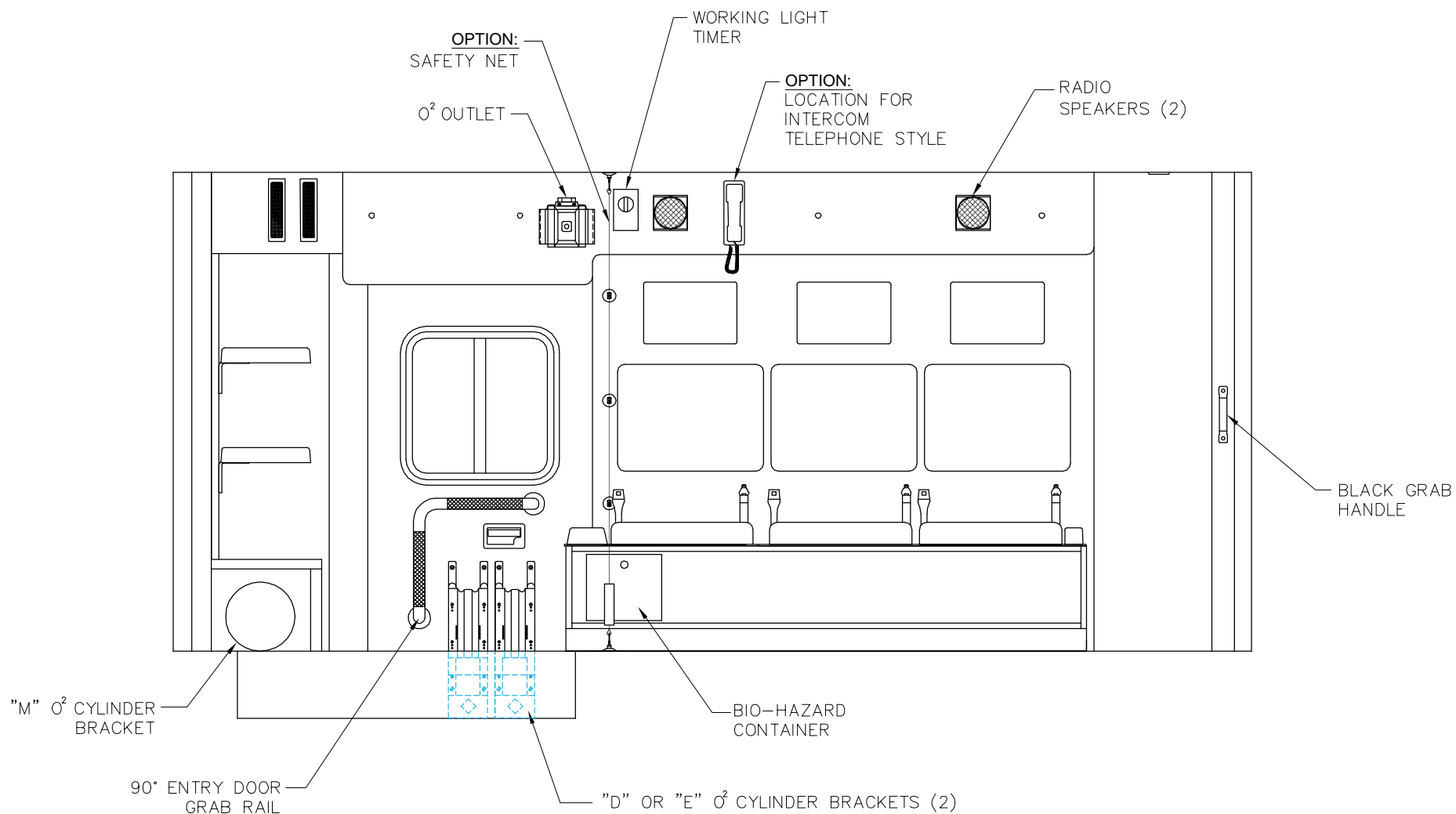
REV.: 0 DATE: 19/02/03

# BOITE : B800606



NOTES: 1-DRAWING MAY SHOW SOME OPTIONS  
2-ELECTRIC DOOR LOCK ON ALL MODULE DOORS IN OPTION

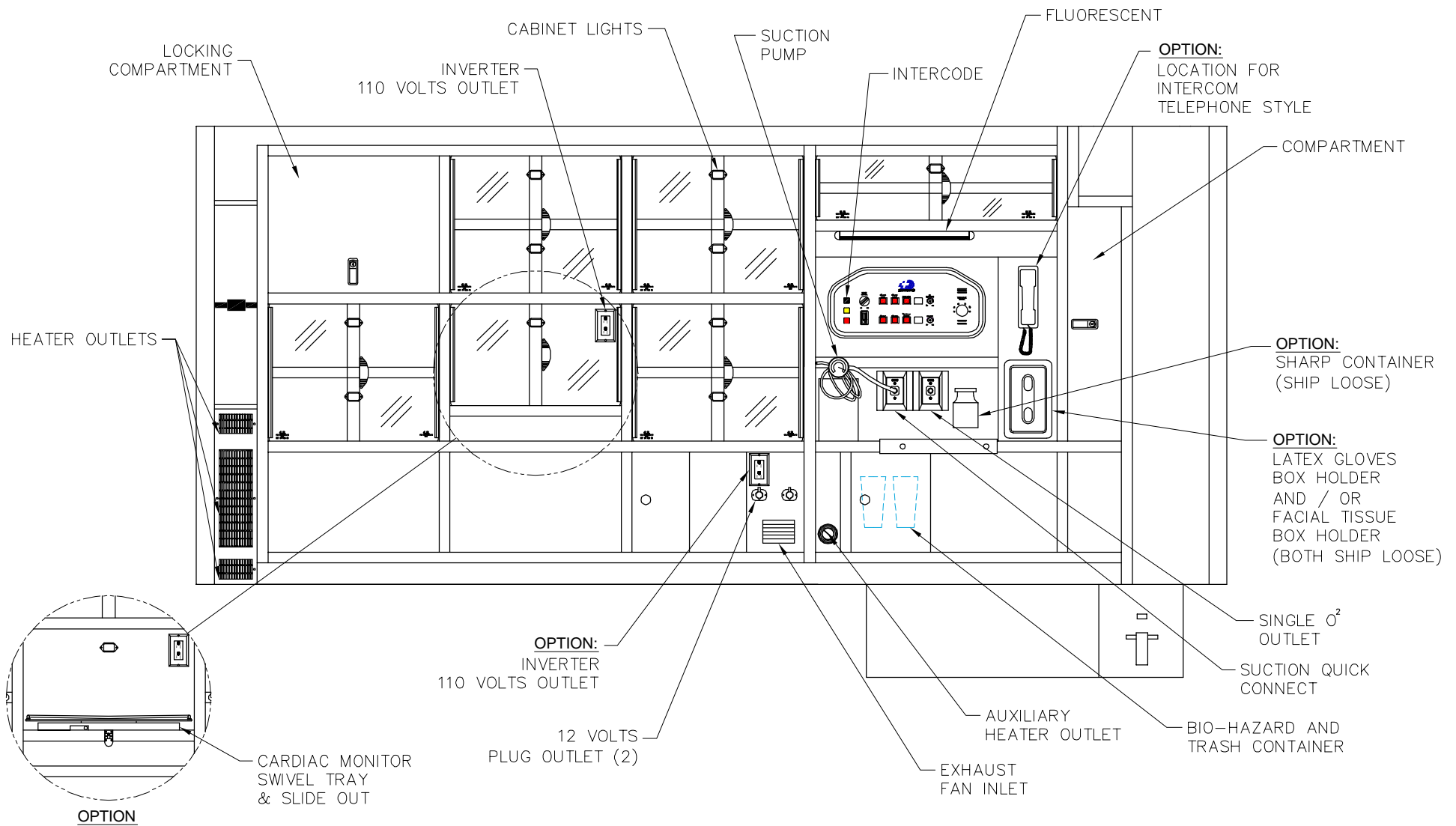
DESCRIPTION : TYPE I – REAR END				# DESSIN / DRAWING NO.	
CONTRAT/CONTRACT : MYSTÈRE MXP144E	CHASSIS/FRAME FORD	MODELE/MODEL F-350	DESS./DRAW. : C. ZBINDEN	12FD-F350XXX-B3-0024	
	ECH./SCALE 1:25	PAGE 1 / 1	VENT./SALES : D.R. / D.M.	REV.: 0	DATE: 20/02/03
			INGEN./ENGIN. : SYLVAIN DEMERS	# BOITE : B800606	



NOTE: 1-DRAWING MAY SHOW SOME OPTIONS

DESCRIPTION : TYPE I – RIGHT WALL – SINGLE MAIN COT CONFIG.				# DESSIN / DRAWING NO.	
CONTRAT/CONTRACT : MYSTÈRE MXP144E	CHASSIS/FRAME FORD	MODELE/MODEL F-350	DESS./DRAW. : C. ZBINDEN	31FD-F350XXX-B3-0025	
	ECH./SCALE 1:20	PAGE 1 / 1	VENT./SALES : D.R. / D.M.	REV.: 0	DATE: 20/02/03
			INGEN./ENGIN. : SYLVAIN DEMERS	# BOITE : B800606	

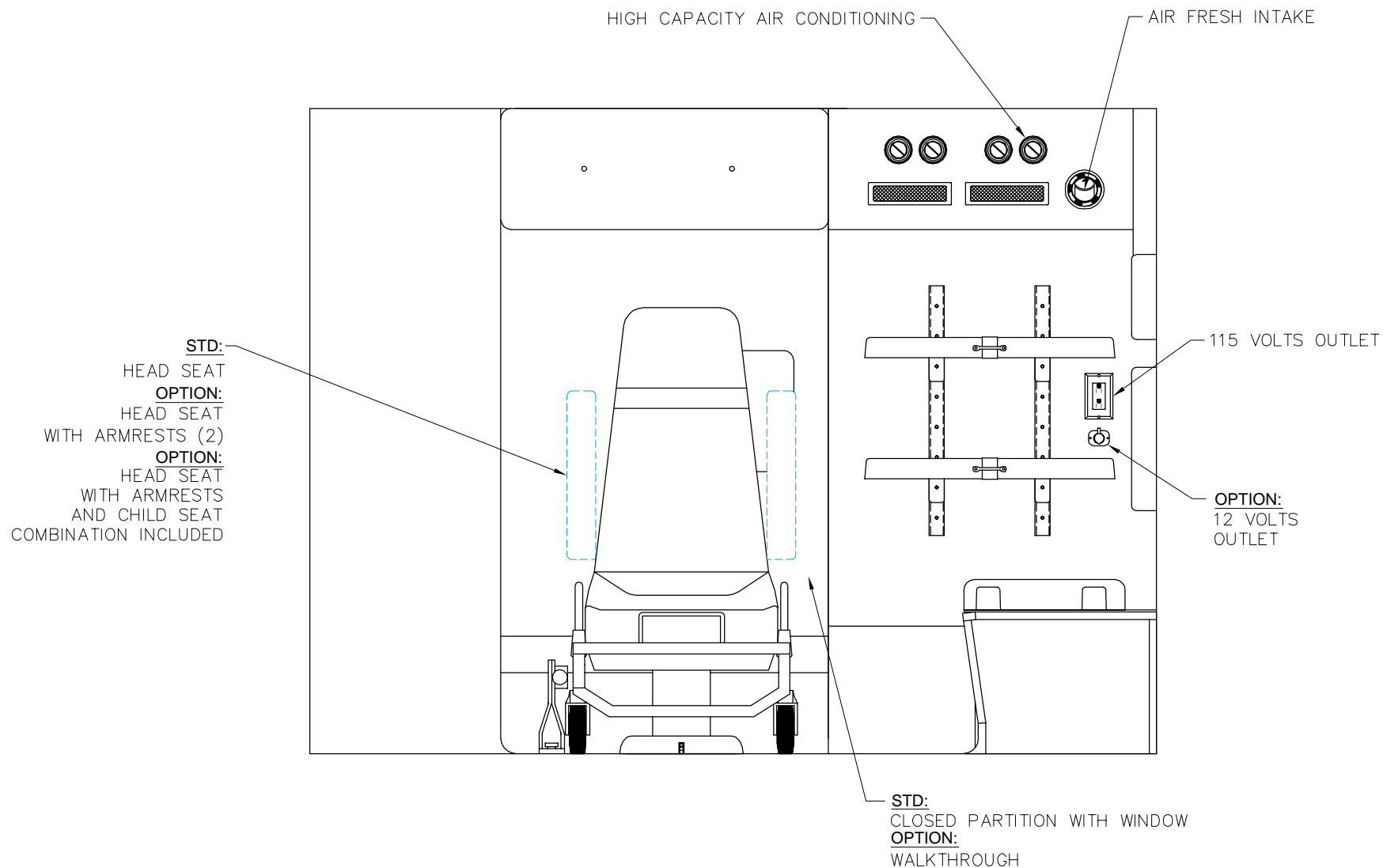




NOTE: 1-DRAWING MAY SHOW SOME OPTIONS



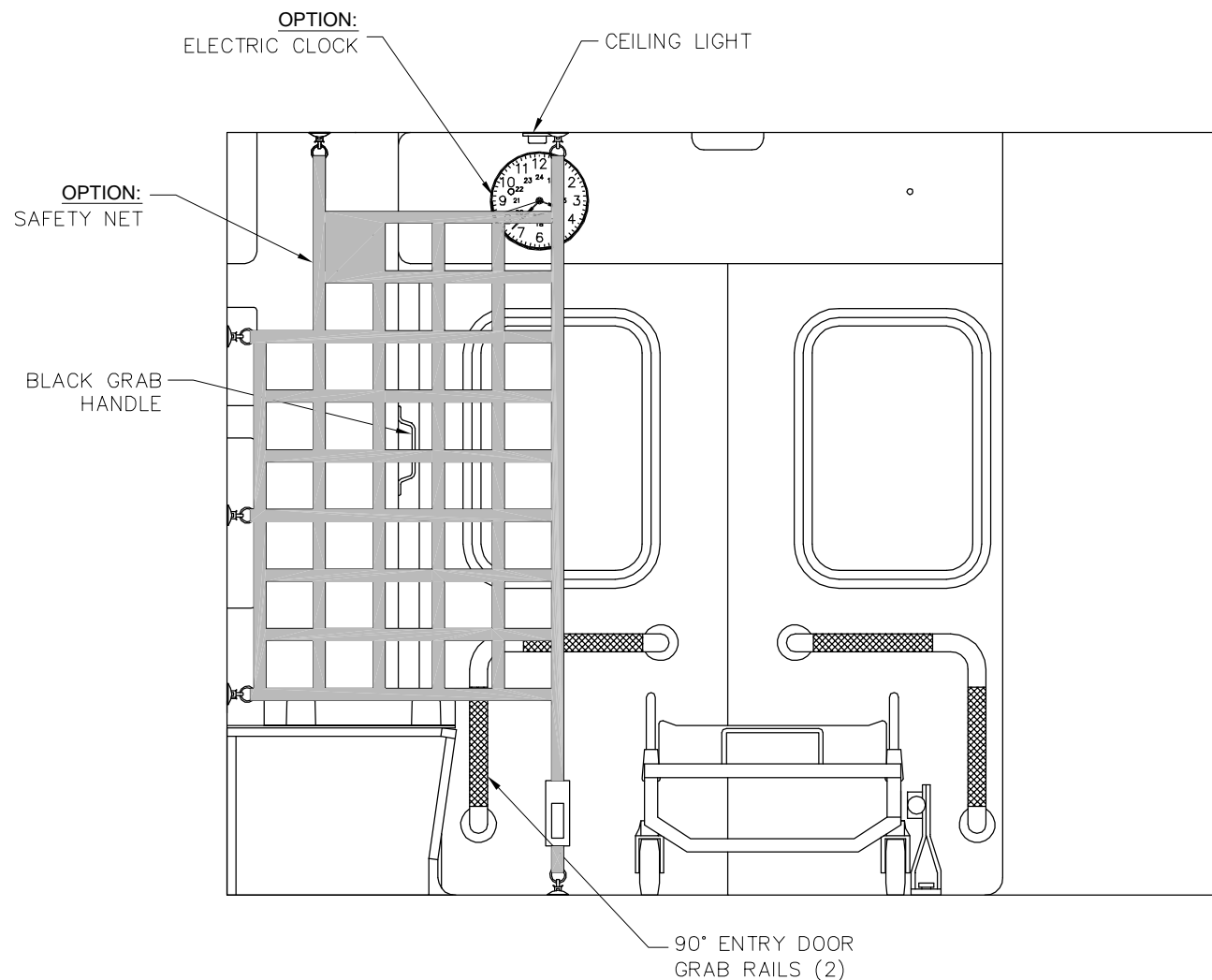
DESCRIPTION : TYPE I – LEFT WALL STANDARD CABINETRY				# DESSIN / DRAWING NO.	
CONTRAT/CONTRACT : MYSTÈRE MXP144E	CHASSIS/FRAME	MODELE/MODEL	DESS./DRAW. :	12FD-F350XXX-B3-0027	
	FORD	F-350	C. ZBINDEN		
	ECH./SCALE	PAGE	VENT./SALES :	REV.: 0	DATE: 20/02/03
	1: 20	1 / 1	D.R. / D.M.	# BOITE : B800606	
			INGEN./ENGIN. : SYLVAIN DEMERS		



NOTE: 1-DRAWING MAY SHOW SOME OPTIONS



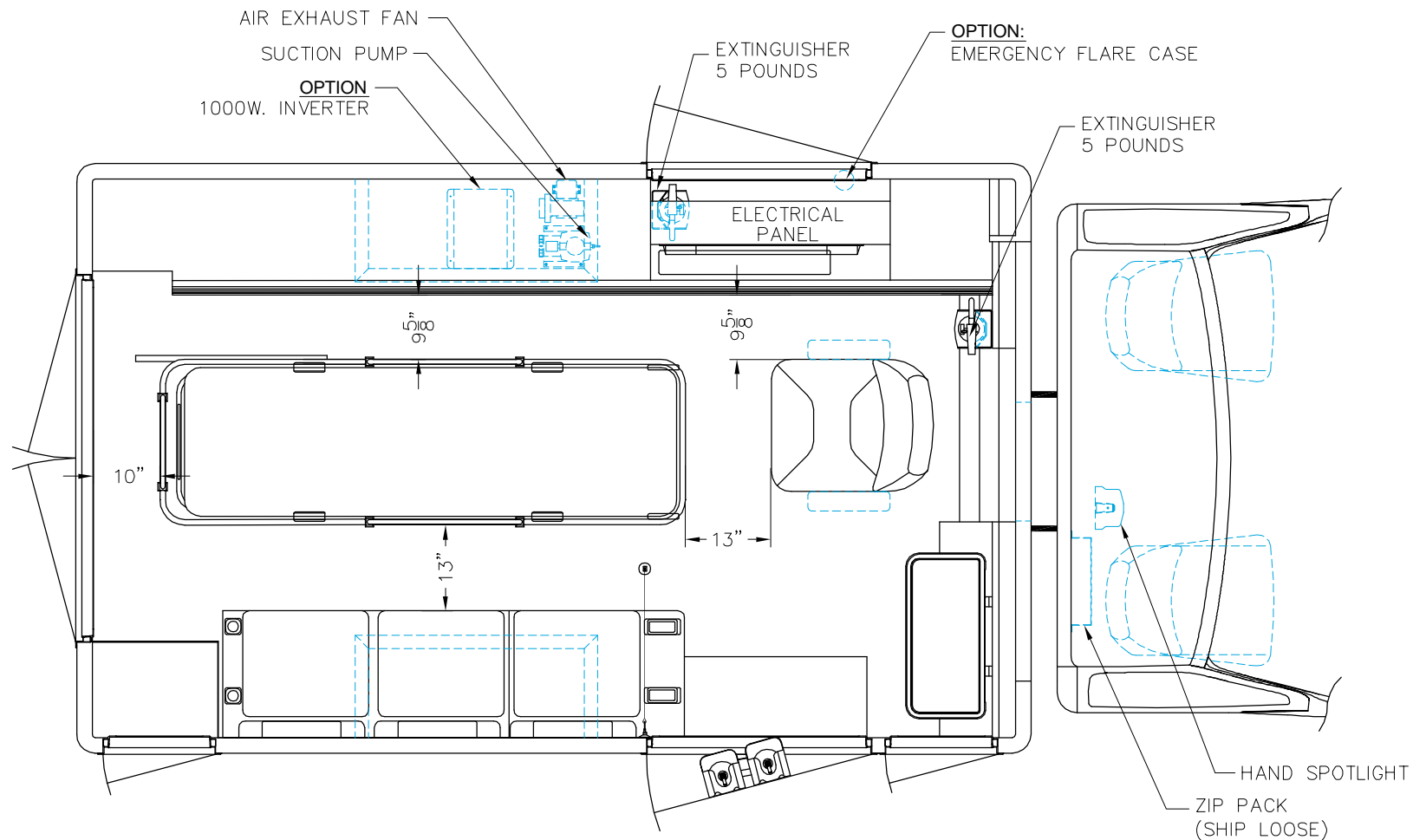
DESCRIPTION : TYPE I – FRONT WALL – SINGLE MAIN COT				# DESSIN / DRAWING NO.	
CONTRAT/CONTRACT :  MYSTÈRE MXP144E	CHASSIS/FRAME	MODELE/MODEL	DESS./DRAW. :	12FD-F350XXX-B3-0028	
	FORD	F-350	C. ZBINDEN		
	ECH./SCALE	PAGE	VENT./SALES :	REV.: 0	DATE: 20/02/03
	1:15	1 / 1	D.R./ D.M.	# BOITE : B800606	
			INGEN./ENGIN. : SYLVAIN DEMERS		



NOTE: 1-DRAWING MAY SHOW SOME OPTIONS



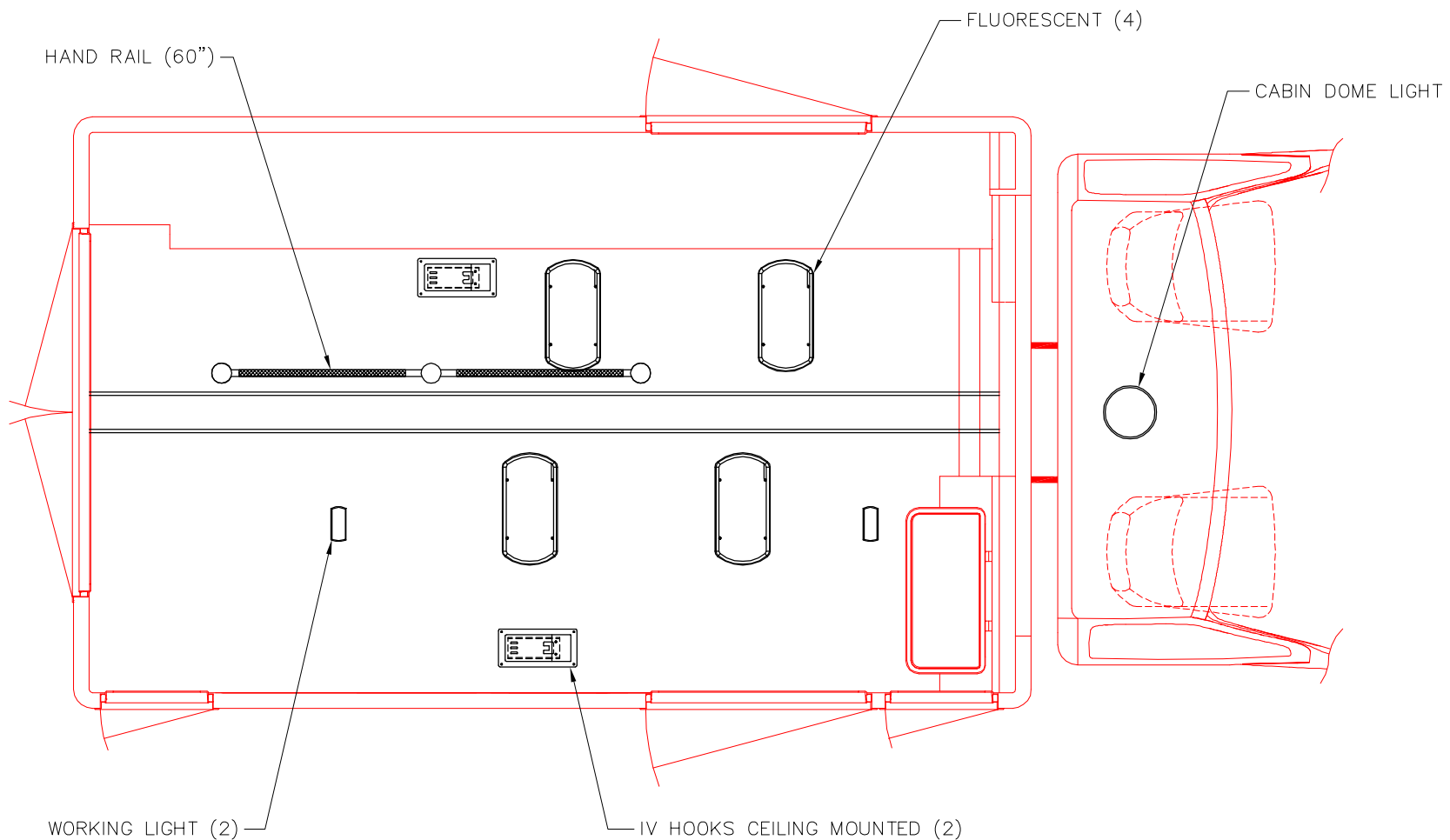
DESCRIPTION : TYPE I – REAR WALL – SINGLE MAIN COT				# DESSIN / DRAWING NO.	
CONTRAT/CONTRACT : MYSTÈRE MXP144E	CHASSIS/FRAME	MODELE/MODEL	DESS./DRAW. :	12FD-F350XXX-B3-0030	
	FORD	F-350	C. ZBINDEN		
	ECH./SCALE	PAGE	VENT./SALES :	REV.: 0	DATE: 20/02/03
	1:15	1 / 1	D.R / D.M.		
			INGEN./ENGIN. :	# BOITE : B800606	
			SYLVAIN DEMERS		



NOTE: 1-DRAWING MAY SHOW SOME OPTIONS



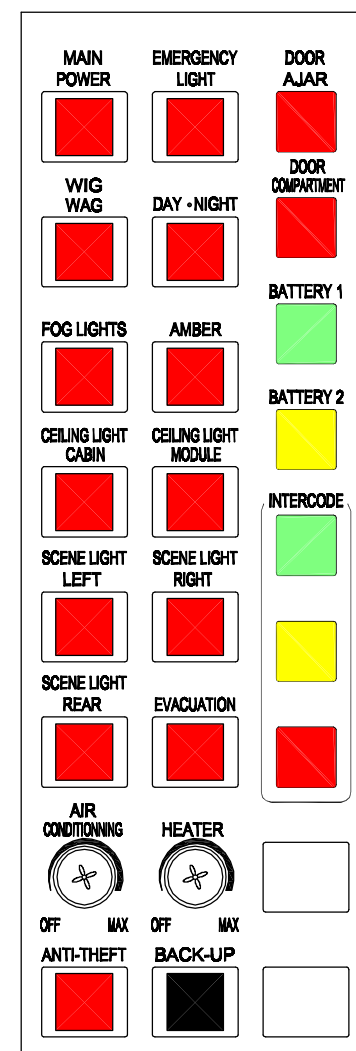
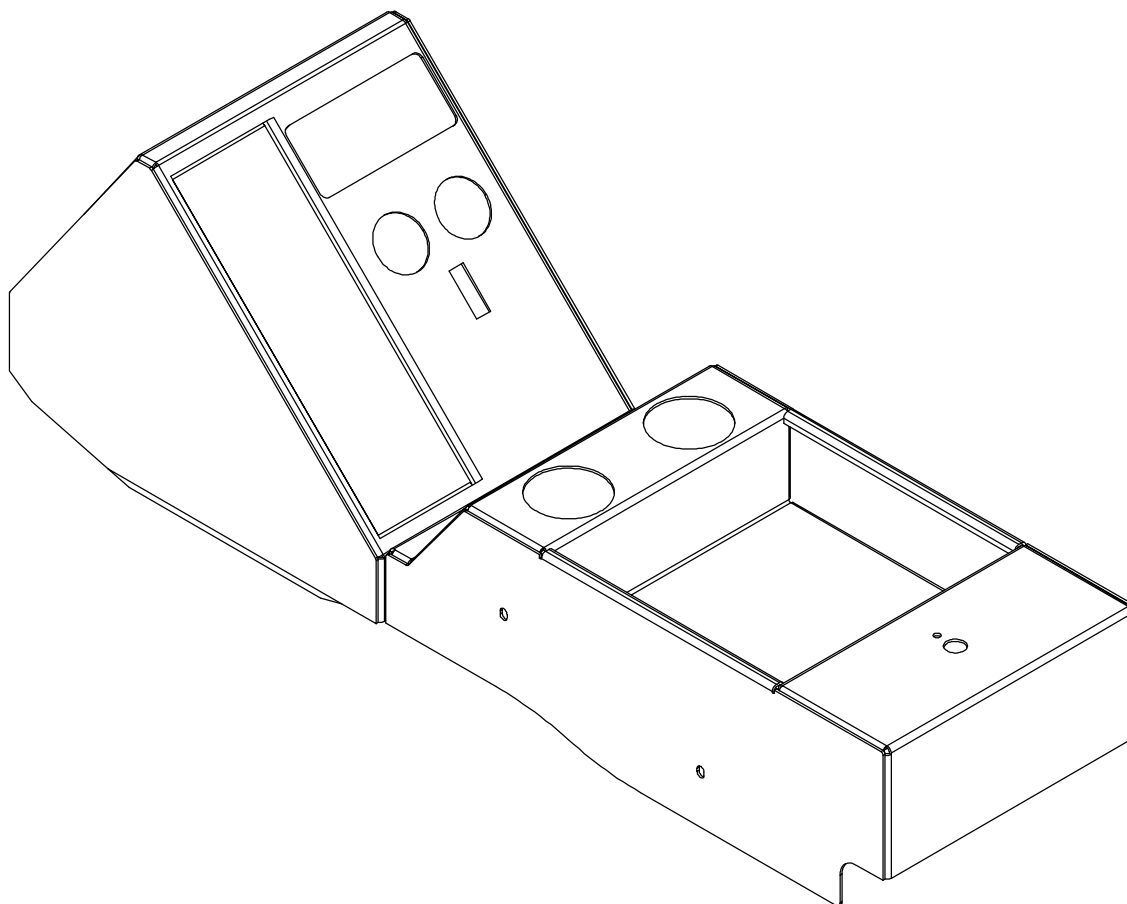
DESCRIPTION : TYPE I – FLOOR VIEW – SINGLE MAIN COT				# DESSIN / DRAWING NO.	
CONTRAT/CONTRACT : MYSTÈRE MXP144E	CHASSIS/FRAME FORD	MODELE/MODEL F-350	DESS./DRAW. : C. ZBINDEN	12FD-F350XXX-B3-0032	
	ECH./SCALE 1:25	PAGE 1 / 1	VENT./SALES : D.R. / D.M.	REV.: 0	DATE: 20/02/03
			INGEN./ENGIN. : SYLVAIN DEMERS	# BOITE : B800606	

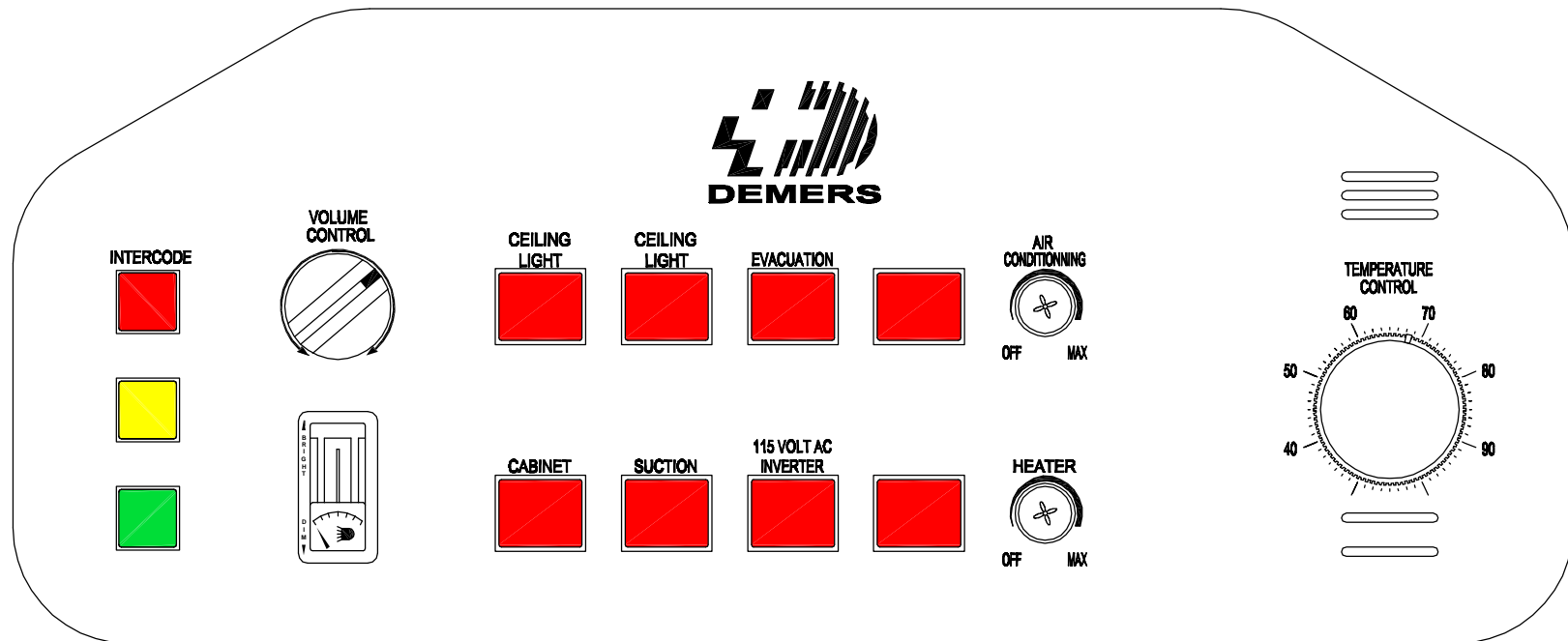


NOTE: 1-DRAWING MAY SHOW SOME OPTIONS

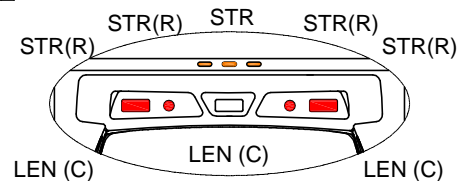
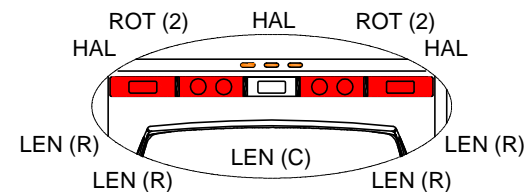
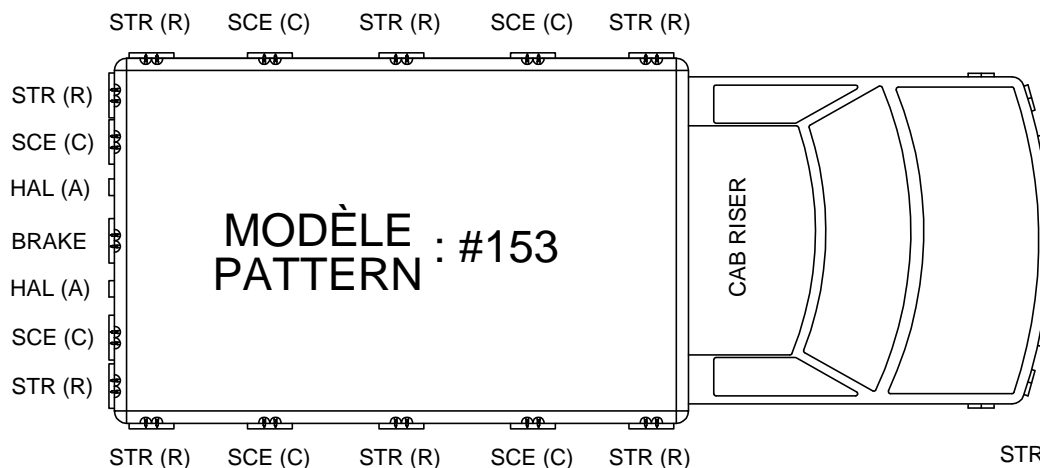
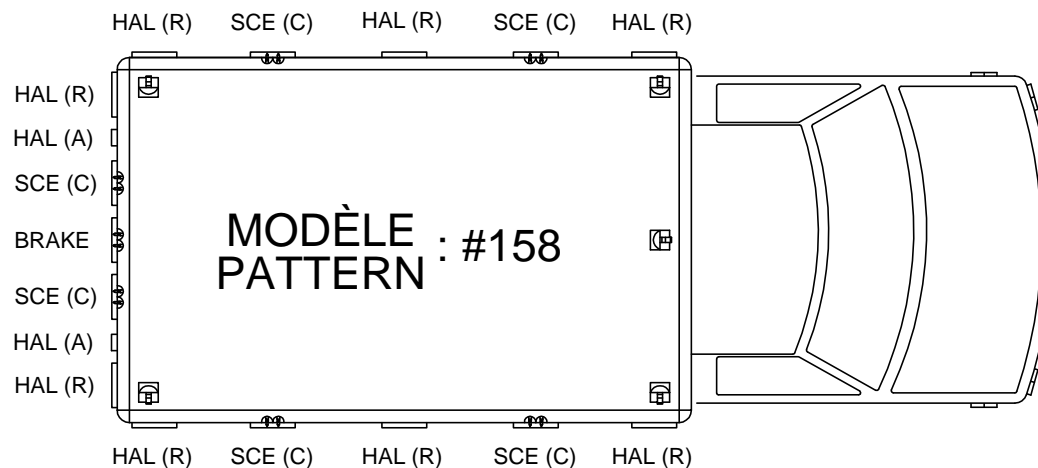


DESCRIPTION : TYPE I – INTERIOR LIGHT LOCATION				# DESSIN / DRAWING NO.	
CONTRAT/CONTRACT : MYSTÈRE MXP144E	CHASSIS/FRAME	MODELE/MODEL	DESS./DRAW. :	12FD-F350XXX-B3-0034	
	FORD	F-350	C. ZBINDEN		
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				INGEN./ENGIN. : SYLVAIN DEMERS	
				# BOITE : B800606	



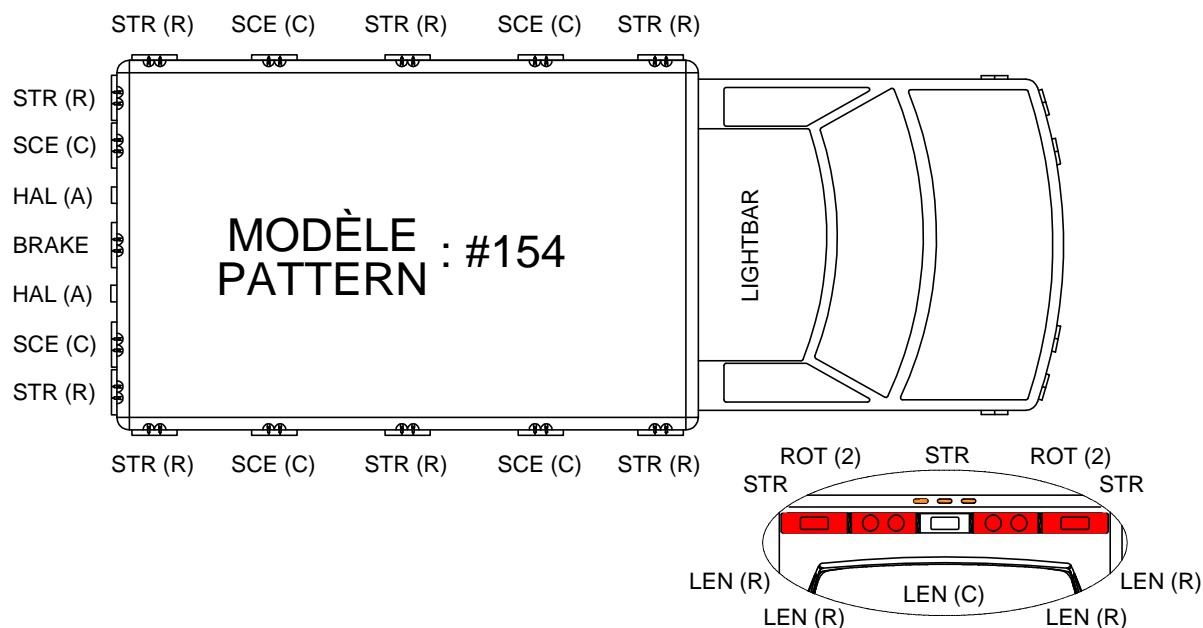
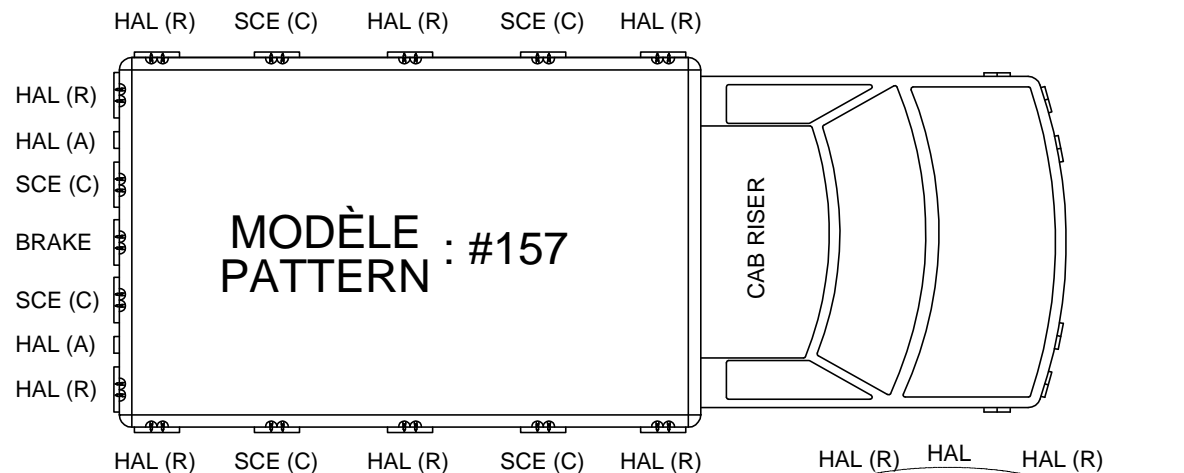


LEGEND	
ROT	- ROTATOR
HAL	- HALOGEN LIGHT
STR	- STROBE LIGHT
SCE	- SCENE LIGHT
BRAKE	- HIGH MOUNTED STOP LAMP
LEN	- LENS
(R)	- RED COLOR
(C)	- CLEAR COLOR
LED	- LIGHT EMITTING DIODE
(A)	- AMBER COLOR
EXAMPLE ROT (R) : ONE ROTATOR WITH A RED LENS	



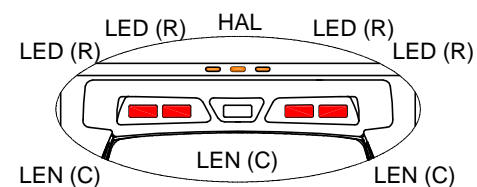
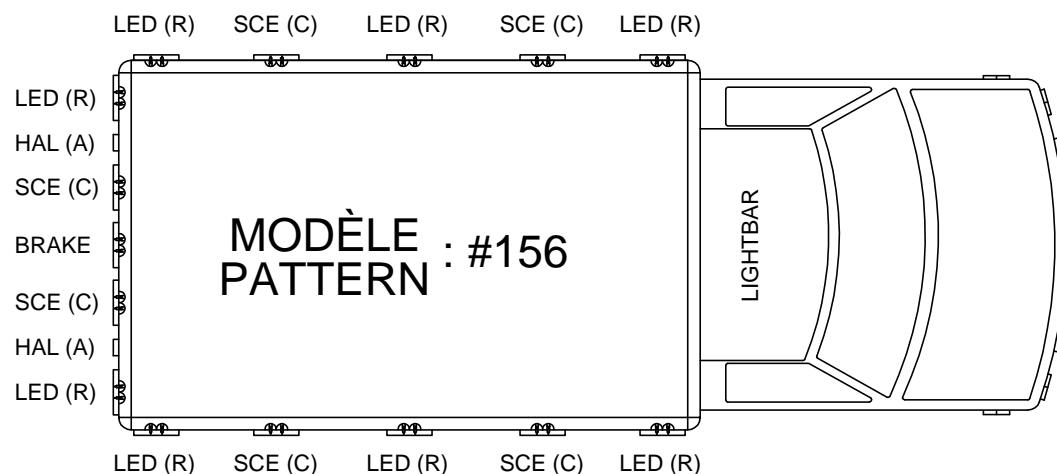


LEGEND	
ROT	- ROTATOR
HAL	- HALOGEN LIGHT
STR	- STROBE LIGHT
SCE	- SCENE LIGHT
BRAKE	- HIGH MOUNTED STOP LAMP
LEN	- LENS
(R)	- RED COLOR
(C)	- CLEAR COLOR
LED	- LIGHT EMITTING DIODE
(A)	- AMBER COLOR
EXAMPLE	
ROT (R) : ONE ROTATOR WITH A RED LENS	



DESCRIPTION : TYPE III – LIGHT PATTERN					# DESSIN / DRAWING NO.	
CONTRAT/CONTRACT :    MX144E	CHASSIS/FRAME	MODELE/MODEL	DESS./DRAW. :	Z0000198		
	FORD	E-350	YANNICK ADDY			
			VENT./SALES :	REV.: 1	DATE: 29/04/02	
	ECH./SCALE	PAGE	INGEN./ENGIN. :	# BOITE : B800601		
	1 : 35	2 / 3	SYLVAIN DEMERS			

LEGEND	
ROT	- ROTATOR
HAL	- HALOGEN LIGHT
STR	- STROBE LIGHT
SCE	- SCENE LIGHT
BRAKE	- HIGH MOUNTED STOP LAMP
LEN	- LENS
(R)	- RED COLOR
(C)	- CLEAR COLOR
LED	- LIGHT EMITTING DIODE
(A)	- AMBER COLOR
EXAMPLE ROT (R) : ONE ROTATOR WITH A RED LENS	



DESCRIPTION : TYPE III – LIGHT PATTERN				# DESSIN / DRAWING NO.	
CONTRAT/CONTRACT :  MX144E	CHASSIS/FRAME	MODELE/MODEL	DESS./DRAW. :	Z0000198	
	FORD	E-350	YANNICK ADDY		
	ECH./SCALE	PAGE	VENT./SALES :	REV.: 1	DATE: 29/04/02
	1 : 35	3 / 3	INGEN./ENGIN. : SYLVAIN DEMERS	# BOITE : B800601	



## OPTIONS

		Unit price	Total price
15	<input type="checkbox"/> Reverse sensing system (2180, 5.5180, 10180)		
16	<input type="checkbox"/> CPC III electronic controlograph (note: requires computer software) (10013)		
17	<input type="checkbox"/> CPC III electronic controlograph and speed 2 (note: requires computer software) (10015)		
18	<input type="checkbox"/> Modify original door trays (12193)		
19	<input type="checkbox"/> Storage space for documents (delete std document case) (8137)		

## MEDICAL CABINET

2

- 20 • Aluminium frame with fibreglass compartments with lighting and (1) 115 V.AC outlet
- 22 • Exterior location for backboards /spine boards
- 24 • Shelf slider divider in cavities (8)
- 25 • Tinted polycarbonate window in cabinet

## CHASSIS

3

- 26 • Chassis
  - FORD E-350 Cutaway 2004
- 27 • Engine
  - 6.0L Diesel V8 Power Stroke
- 28 • Wheelbase
  - 138 in. (3,505 mm)
- 29 • Transmission
  - Electronic 5-Speed Automatic O/D
- 30 • Audio
  - Electronic AM/FM/Cassette - stereo with clock
  - Includes 4 speakers
- 31 • GVWR
  - 10,700 Lbs / 4853 Kg (Gross vehicle weight rating)
- 32 • Ambulance Preparation Package (47A) - Summary -
  - Air Conditioning connector package
  - 4.10 limited slip axle ratio
  - Dual alternator : 220A total
  - Auxiliary idle control, limited fonction
  - Driver & Passenger air bag
  - Tilt steering wheel

## OPTIONS

Unit price      Total price

- 33 ☐ Dual cloth captain's chairs
- 34 ☐ Exterior upgrade package
- Front chrome bumper
  - Aerodynamic headlamps
- 35 ☐ Interior upgrade package
- Front cloth headliner
  - High series door trim panels
  - Cloth sunvisors
  - Power door lock/windows
  - Insulation package
- 37 ☐ Speed control

**Some options may differ in availability according to market**

## OXYGEN

4

- 38 • "D" OR "E" Oxygen cylinder brackets (2)
- 39 • Horizontal holders for main oxygen bottle type "K" to "M" on the floor between the driver and patient compartments
- 40 • Oxygen outlets (3) with flow meter (0-15LPM) : 1 at right on wall and 2 at left in ECC
- 41 • Oxygen regulator (50 PSI)

## MODULE

5

- 43 • All aluminium module (Certified to KKK-A-1822, QVM, FMVSS, CMVSS, AMD)
- 44 • Overall dimensions
- 144" [3658 mm] long x 89" [2260 mm] wide
  - Interior headroom 64"
- 45 • Module frame
- High strength aluminium sections
- 46 • Panels and structure
- Single piece sheet [Marine environment resistance]
  - Panel thickness of 0.090" [2.300 mm]
  - Wall structure : 0.090" [2.300 mm] high strength aluminium sections
- 47 • Assembly method
- Acid preparation on the exterior structures (enhance bonding)
  - High structural elastic adhesive assembly of the wall panels to the wall structure
  - Rivets assembly of the floor panel to the floor structure
- 48 • Left configuration
- 1 door midway for equipment access

- 49 • Right configuration
  - 1 door with window at midway for patient compartment access
  - 1 door at front for batteries and “M” oxygen cylinder access
  - 1 door at rear for backboards/spineboards
- 50 • Rear configuration
  - 2 doors with windows for patient loading
- 51 • Roof configuration
  - Single piece sheet continuously welded [Marine environment resistance]
  - Perimeter with built-in drip rail
- 52 • Floor configuration
  - Single piece sheet [Marine environment resistance]
  - Aluminium wheel well liner, thickness of 0.125” [3.175 mm]
  - Panel thickness of 0.060” [1.524 mm]
  - Step well : aluminium checker plate of 0.090” [2.300 mm]
- 53 • Doors configurations
  - Single piece sheet
  - Drip rail over all doors
  - Exterior panel thickness of 0.125” [3.175 mm]
  - Interior panel thickness of 0.090” [2.300 mm]
  - Door structure : 0.125 “ [3.175 mm] high strength aluminium sections
  - Door frame : high strength aluminium sections (enable dual gasket)
- 54 • 10 module to chassis rubber mount points
- 55 • Hardware
  - Door hold open device
  - Emergency door open device
  - Stainless steel piano hinges
  - Two (2) double stage rotary latches controlled through metal rods and “Trimark” black powder coat paddle handles.

## OPTIONS

		Unit price	Total price
56	<input type="checkbox"/> Electric door lock on all module doors (5) (req. Door lock on chassis) (2, 5, 12084)		

## PAINT DECALS AND LETTERING

6

- 57 • White exterior paint : High built polyurethane surface paint by BASF over epoxy primer and two (2) acid stabilizing treatment to prevent galvanic/corrosion and provide high adhesion for epoxy primer. **\*\*\* Do not meet KKK specification**

## OPTIONS

		Unit price	Total price
58	<input type="checkbox"/> Striping and identifications	Price on request	

## PATIENT COMPARTMENT

7

- 59 • ABS thermoplastic interior finish
- 60 • Action wall console (ECC)
  - Switches and commutators
  - Fluorescent lamp in ECC
  - Intercode lighting system with buzzer
  - Rear speaker volume control
  - Thermostat; (dual stage) for A/C and heater
- 61 • Air conditioning unit
- 62 • Bio hazard container on the forward of the squad bench
- 63 • Entry door areas with 3 chrome grab rails and 2 black grab handles
- 64 • Exhaust fans (2) for contaminated air
- 65 • Fire extinguisher (5 lbs) ABC with heavy duty bracket (1)
- 66 • Flooring: 5/8 in. (16mm) exterior grade plywood
- 67 • Glass : side (sliding) and rear (fixed) door privacy tinted
- 68 • Gooseneck light at the head of the primary patient
- 69 • Hand-rail on ceiling 63 in. (1600 mm)
- 70 • Head seat : thermoformed with safety belt and turning base (14100)
- 71 • Heating unit
- 72 • Insulation : thermal and acoustical
- 73 • IV hooks (2) ceiling recessed
- 74 • Locking compartment in medical cabinet
- 75 • Low and high intensity patient compartment fluorescent lights (4), low intensity patient compartment dome light (1) with 10 seconds delay shut off
- 76 • Partition with self latching sliding window only (8034, 9034)
- 77 • Radio speakers (2)
- 78 • Rolling cot fastener (STRYKER), cot not supplied
- 79 • Slip resistant, bacteriostatic and anti-static floor covering material .078 in. (2mm) thickness rolled-up 3 in. (75mm)
- 80 • Squad bench for 3 passengers, safety belts and thermoformed molded cushions to receive combination stretcher/chair
- 81 • Suction pump with collection bottle and uni-service bag
- 82 • Trash container at the bottom of the ECC
- 83 • Working lights (2) with 0-15 minutes timer



**DEMERS  
AMBULANCES**

28, Richelieu, Beloeil (Quebec) J3G 4N5

**MYSTERE**

16/11/2004

## OPTIONS

		Unit price	Total price
84	<input type="checkbox"/> Cardiac monitor tray, sliding and turning (11048)		
85	<input type="checkbox"/> Clock (battery powered) with light (9055)		
86	<input type="checkbox"/> Facial tissue box holder (Ship loose) (9143)		
87	<input type="checkbox"/> Hand-rail (18 in) (specified location _____) (9040)		
88	<input type="checkbox"/> Hand-rail (36 in) (specified location _____) (9097)		
89	<input type="checkbox"/> Head seat with two (2) armrests :thermoformed (Replace std head seat) (14099)		
90	<input type="checkbox"/> Head seat without armrest equipped with child safety device : thermoformed (Replace std head seat) (14227)		
91	<input type="checkbox"/> Intercom: telephone style (specified location) *** Right: _____ Left: _____ (right 5, 10019) (left 5, 10020)		
92	<input type="checkbox"/> Latex gloves box holder (ship loose) (9043)		
93	<input type="checkbox"/> Needle container (9101)		
94	<input type="checkbox"/> Safety net at front end of the squad bench (11, 13050)		
95	<input type="checkbox"/> Self latching sliding door on partition (8035, 9035)		

## POWER DISTRIBUTION AND CONTROL SYSTEM

8

- 98 • Alternators (2) of 110 amps each
- 99 • Batteries (4) : (2) OEM, (2) auxiliary (4,518)
- 100 • Electrical outlets (2) 12 V. DC, cigarette lighter type : (2) at patient head
- 101 • Shoreline with (2), 115V A/C interior outlets (2, 6007)

## OPTIONS

		Unit price	Total price
102	<input type="checkbox"/> Auto-eject shoreline (replace standard shoreline) (2, 6005)		
103	<input type="checkbox"/> Isolator & battery switch for auxiliary batteries (4, 5217)		
104	<input type="checkbox"/> Power inverter ( 12 V.DC to 115 V.AC,1000 Watt) also includes cigarette lighter plug (10 AMPS) in the first aid kit storage (4, 7, 10, 13011)		
105	<input type="checkbox"/> Power inverter (Supplied by others) ( 12 V.DC to 115 V.AC,1000 Watt) also includes cigarette lighter plug (10 AMPS) in the first aid kit storage (4, 7, 10, 13012)		



## VEHICLE FEATURES

9

- 106 • Anti-skid lateral steps angle to match module width includes: mud guards
- 107 • Convex mirrors (2) (12234)
- 108 • Directional and gabarit lights (L.E.D.)
- 109 • High mount rear brake light (10131)
- 110 • Rear retractable anti-skid step
- 111 • Reinforced rear door-open device
- 112 • Turning lights (2) intermediate side mounted
- 113 • Undercoating protection
- 114 • Under frame spare tire location

## OPTIONS

		Unit price	Total price
116	<input type="checkbox"/> Aluminium rub-rail (1190)		
117	<input type="checkbox"/> Emergency flare case (8036)		
118	<input type="checkbox"/> High mount rear break light (L.E.D) (delete std break light) (10126)		
118	<input type="checkbox"/> Remote and heated "VELVAC" exterior mirrors with timer (delete std mirrors) (5, 6104, 12104)		
118	<input type="checkbox"/> Stainless steel wheel simulators (14071)		
119	<input type="checkbox"/> Tow hooks (2) at rear (1003)		
120	<input type="checkbox"/> Ultra sound whistle for animals (one on each side) (9044)		

## EMERGENCY LIGHTS & SIREN

10

- 121 • Back up alarm (97db) with override switch
- 122 • Intersection red halogen lights (2) mounted in angled aluminium bezels (6107)
- 123 • Lateral scene lights (2) on each side : total of (4)
- 124 • Light bar, flush mount with 2 red and 1 clear (central) halogen flashing lights and 4 red rotating lights.
  - Module : 6 red halogen flashing lights (2, 5, 6, 8, 10158)
  - Fibreglass moulded grille (white) includes: halogen red lights (2) and 100 watt speakers (2)
- 125 • Rear amber halogen lights (2)
- 126 • Rear amber halogen turning arrows (2) at middle height (10089)
- 127 • Rear loading halogen lights (2)
- 128 • Siren amplifiers (100 watt) with 4 tones and Public address (P/A) microphone
- 129 • Wig Wag headlamps

**\*\* 2004 models comes std with "WHELEN" products.**

## OPTIONS

		Unit price	Total price
130	<input type="checkbox"/> Amber halogen fog lights with covers (6032)		
131	<input type="checkbox"/> Clear halogen fog lights with covers (6033)		
132	<input type="checkbox"/> Front L.E.D red lights (2) on front valance and 2 additional rear L.E.D. lights (2, 6, 10225) at windows height (N/A with 2, 10088)		
133	<input type="checkbox"/> Intersection red halogen lights with clear halogen turning lights (Delete STD intersection lights) (6106)		
134	<input type="checkbox"/> Intersection red strobe lights (2) mounted in angled aluminium bezels (5, 6214) (Delete STD intersection lights) (N/A with 2, 3, 5, 6, 8, 10157 and 2, 5, 6, 8, 10158)		
135	<input type="checkbox"/> Rear amber L.E.D. lights turning arrows (2) at middle height (Delete std turning arrows) (10125)		
136	<input type="checkbox"/> Rear red halogen lights (2) additional at windows height (2, 10088) (N/A with 2, 6, 10225 and 2, 5, 6, 8, 10154)		

## OPTIONS - EMERGENCY LIGHTING PACKAGE

- 137 ☐ Aerodynamic cabin roof with 4 red and 1 clear (central) with clear lens flashing lights.  
Module : 6 red halogen flashing lights and fibreglass moulded grille (white) includes:  
halogen red lights (2) and 100 watt speakers (2) (2, 3, 5, 6, 8, 10157)
- 138 ☐ Light bar, flush mount with 4 red rotating lights, 2 red, 1 clear (central) strobe lights.  
Module : 6 red strobe lights and fibreglass moulded grille (white) includes:  
red strobe lights (2) and 100 watt speakers (2) (2, 5, 6, 8, 10154)

## COMMENTS OR SPECIAL NOTES

- 139 ☐
- 140 ☐
- 141 ☐

**FREIGHT (to be evaluated case by case)**

**TOTAL** *USD*

**FORD FLEET INCENTIVE**

**DISCOUNT**

**NET COST (Taxes not included)** *USD*

**Net Cost**  
**USD**

This bid is prepared according to your specifications and will become an integral part of your contract.

Also, the buyer acknowledge that by accepting this bid, he committes to take possession of the vehicle according to the delivery agreement between himself and Paul Demers & Fils inc.

All sales are payable upon delivery by certified cheque, bank transfer and or by financing contract prepared and signed on delivery date.

**Estimated delivery date :**

\_\_\_\_\_  
# 0  
Demers Ambulances 0

The parties acknowledge that the Employee, in performing his duties, is solely acting as an employee of Demers Ambulances and is not authorised to assume any liabilities, duties or obligations, enter into any transaction in the name of Demers Ambulances nor bind Demers Ambulances. Any and all transaction to entered into on behalf of Demers Ambulances shall be authorised by a director, officer or any other representative of Demers Ambulances at the head office of Demers Ambulances situated in Beloeil, province of Quebec, Canada.

\_\_\_\_\_  
Yves Demers  
Demers Ambulances

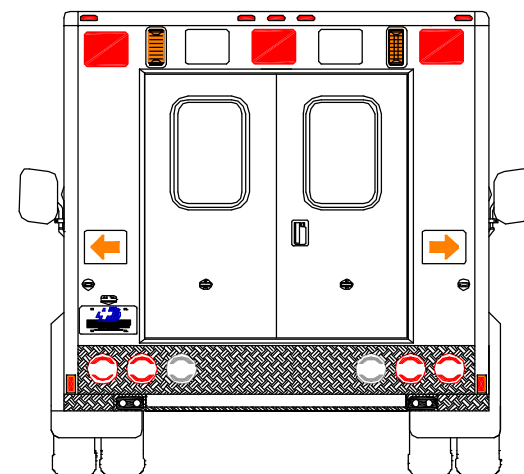
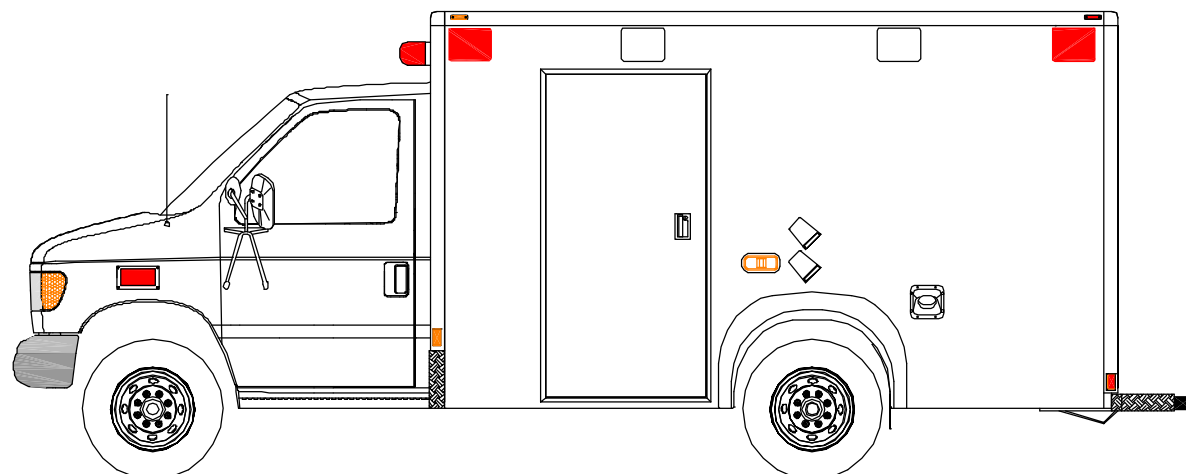
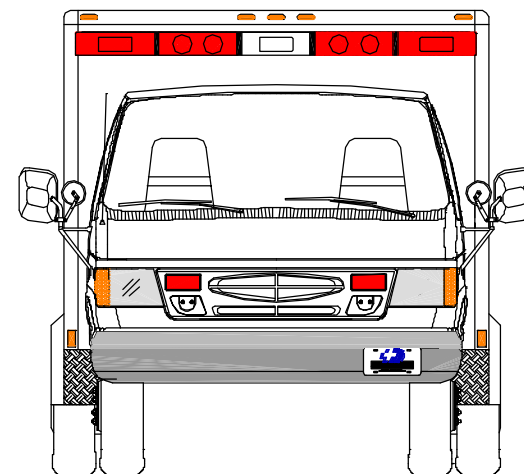
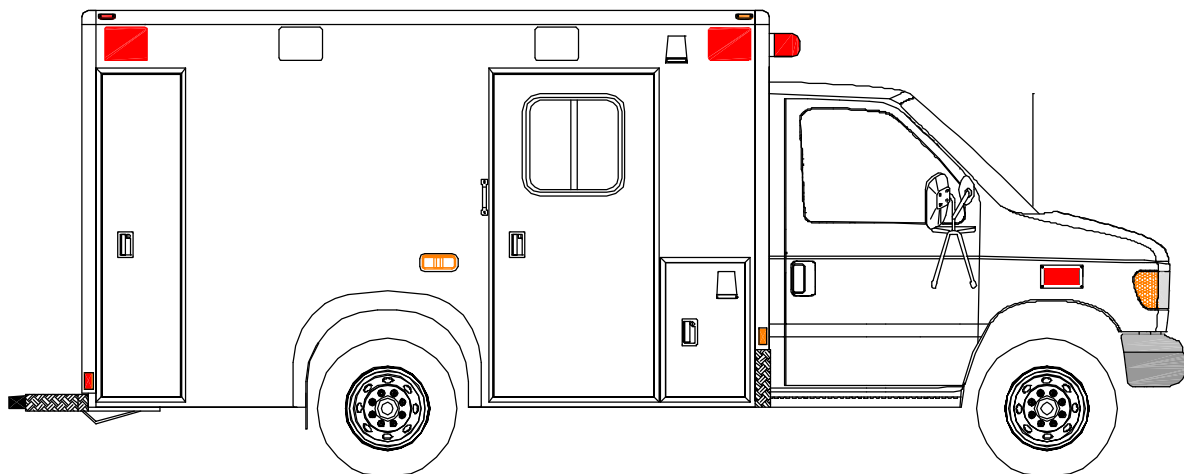
\_\_\_\_\_  
Date of the final approbation  
Corporate Headquarters - (Beloeil) Canada

## CUSTOMER SPECIAL REQUIREMENTS FORM

Description	Article	Initials
<input checked="" type="checkbox"/> <b>Outside rearview mirrors</b> We do not require that the hardware and mirror heads be chromed, polished stainless steel, or polished aluminium.	3.9.5	_____
<input checked="" type="checkbox"/> <b>Body Accomodations</b> We require that the ambulance can accomodate and store only the stretchers, cots and litters of style 1,2 and 3.	3.10.1	_____
<input checked="" type="checkbox"/> <b>Interior Storage Accomodations</b> <b>- Trash receptacle compartment and sharps disposal container</b> We do not require that the trash receptacle compartment meets the minimum volume recommended.	3.11.1	_____
<input type="checkbox"/> <b>Intercom System</b> We require a telephone style intercom system and are aware that the system does not meet KKK specifications.	3.14.5	_____
<input type="checkbox"/> <b>Medical, Surgical, and Biomedical Equipment</b> <b>- Electric Clock</b> We require that the electrical clock be battery powered instead of 12V DC chassis powered.	3.15.4 (M3)	_____
<input type="checkbox"/> <b>Emblems &amp; Markings</b> We require the ambulance to be painted matching the chassis color with no stripping, no emblems and no markings.	3.16.2 3.16.4	_____

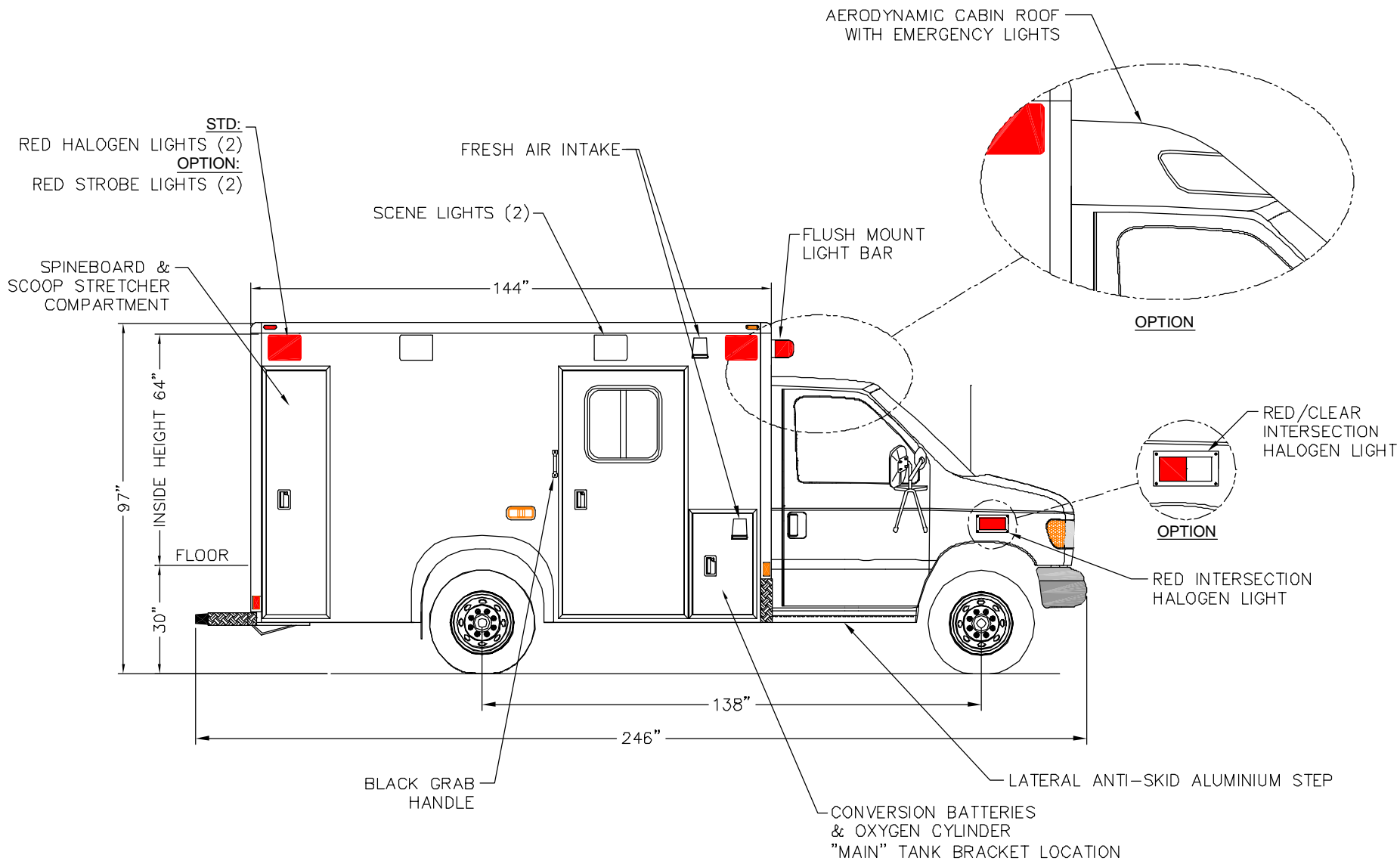
**Note : Customer Special Requirements form shall take precedence on the manufacture's standards, options and KKK-A-1822-E specification.**

# DES. / DWG	REV.	DESCRIPTION	VUE / VIEW	CLIENT
31FD-E350XXX-B4-0080	0	E-350 TYPE III AMBULANCE	GENERAL EXTERIOR	MYSTERE MX144E
31FD-E350XXX-B4-0081	0	E-350 TYPE III AMBULANCE	RIGHT EXTERIOR VIEW	MYSTERE MX144E
31FD-E350XXX-B4-0082	0	E-350 TYPE III AMBULANCE	LEFT EXTERIOR VIEW	MYSTERE MX144E
31FD-E350XXX-B4-0083	0	E-350 TYPE III AMBULANCE	FRONT VIEW	MYSTERE MX144E
31FD-E350XXX-B4-0084	0	E-350 TYPE III AMBULANCE	REAR END VIEW	MYSTERE MX144E
31FD-E350XXX-B4-0085	0	E-350 TYPE III AMBULANCE	RIGHT WALL - SINGLE MAIN COT CONFIG.	MYSTERE MX144E
31FD-E350XXX-B4-0087	0	E-350 TYPE III AMBULANCE	LEFT WALL STANDARD CABINETRY	MYSTERE MX144E
31FD-E350XXX-B4-0088	0	E-350 TYPE III AMBULANCE	FRONT WALL - SINGLE MAIN COT	MYSTERE MX144E
31FD-E350XXX-B4-0090	0	E-350 TYPE III AMBULANCE	REAR WALL - SINGLE MAIN COT	MYSTERE MX144E
31FD-E350XXX-B4-0092	0	E-350 TYPE III AMBULANCE	FLOOR VIEW - SINGLE MAIN COT	MYSTERE MX144E
31FD-E350XXX-B4-0094	0	E-350 TYPE III AMBULANCE	INTERIOR LIGHTS LOCATION	MYSTERE MX144E
31FD-E350XXX-B4-0095	0	E-350 TYPE III AMBULANCE	FRONT CONSOLE	MYSTERE MX144E
31FD-E350XXX-B4-0096	0	E-350 TYPE III AMBULANCE	REAR CONSOLE	MYSTERE MX144E
Z0000227	0	E-350 TYPE III AMBULANCE	LIGHTS PATTERN	MYSTERE MX144E



NOTES: 1-DRAWING MAY SHOW SOME OPTIONS  
2-ELECTRIC DOOR LOCK ON ALL MODULE DOORS IN OPTION

DESCRIPTION : TYPE III – GENERAL EXTERIOR				# DESSIN / DRAWING NO.	
CONTRAT/CONTRACT :	CHASSIS/FRAME	MODELE/MODEL	DESS./DRAW. :	31FD-E350XXX-B4-0080	
	FORD E350	MX144E	YANNICK ADDY		
			VENT./SALES :	REV.: 0    DATE: 12/04/04	
			DANIEL-C ROBITAILLE		
	ECH./SCALE	PAGE	INGEN./ENGIN. :	# BOITE : B800601	
	1 : 40	1 / 1	SYLVAIN DEMERS		



NOTES: 1-DRAWING MAY SHOW SOME OPTIONS  
2-ELECTRIC DOOR LOCK ON ALL MODULE DOORS IN OPTION

DESCRIPTION : TYPE III – RIGHT EXTERIOR VIEW

CONTRAT/CONTRACT :

*MYSTERE*

CHASSIS/FRAME  
FORD E350

ECH./SCALE  
1 : 40

MODELE/MODEL  
MX144E

PAGE  
1 / 1

DESS./DRAW. :  
YANNICK ADDY

VENT./SALES :  
DANIEL-C ROBITAILLE

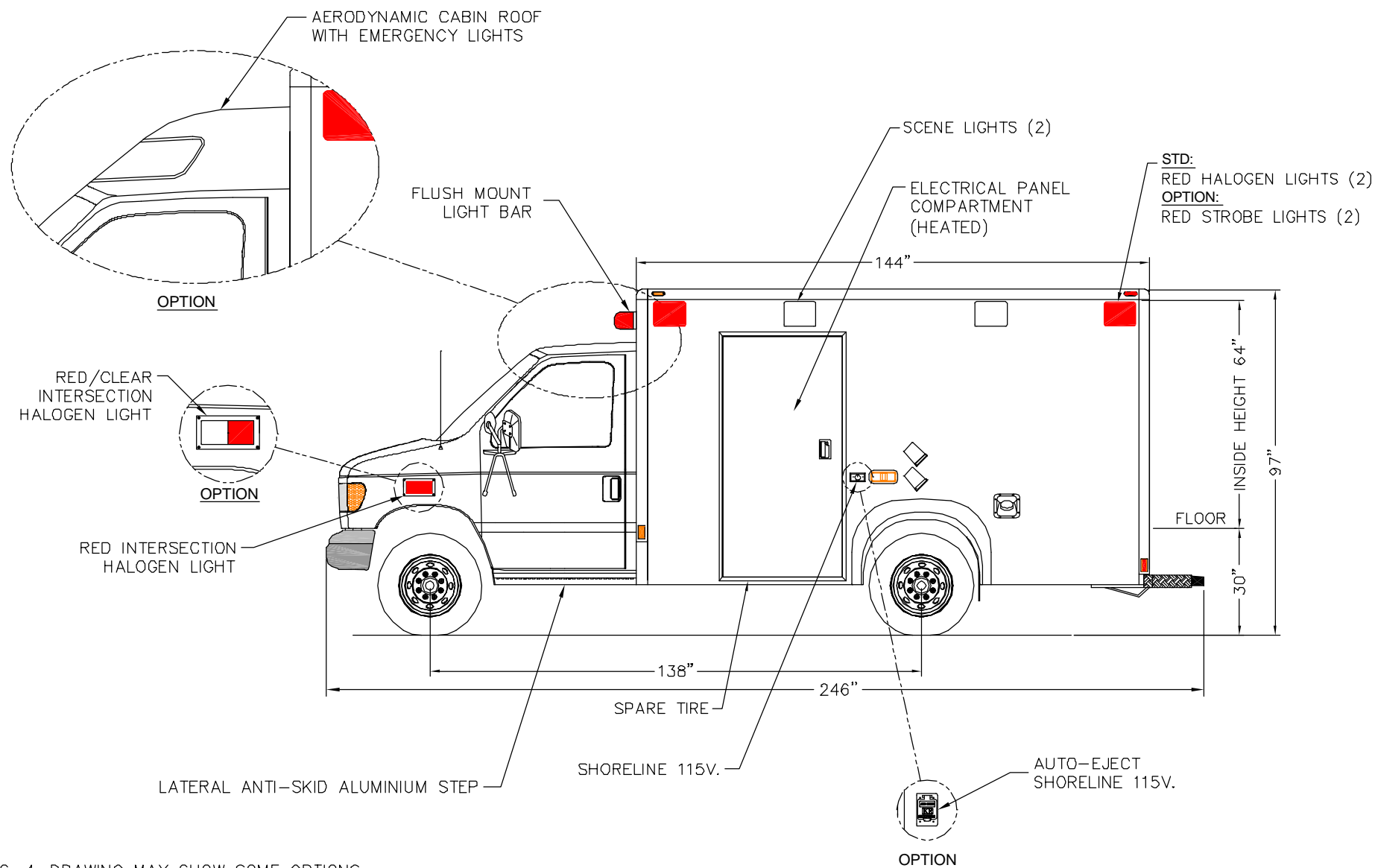
INGEN./ENGIN. :  
SYLVAIN DEMERS

# DESSIN / DRAWING NO.

31FD-E350XXX-B4-0081

REV.: 0 DATE: 12/04/04

# BOITE : B800601



NOTES: 1-DRAWING MAY SHOW SOME OPTIONS  
2-ELECTRIC DOOR LOCK ON ALL MODULE DOORS IN OPTION

DESCRIPTION : TYPE III – LEFT EXTERIOR VIEW

CONTRAT/CONTRACT :

*MYSTERE*

CHASSIS/FRAME  
FORD E350

ECH./SCALE  
1 : 40

MODELE/MODEL  
MX144E

PAGE  
1 / 1

DESS./DRAW. :  
YANNICK ADDY

VENT./SALES :  
DANIEL-C ROBITAILLE

INGEN./ENGIN. :  
SYLVAIN DEMERS

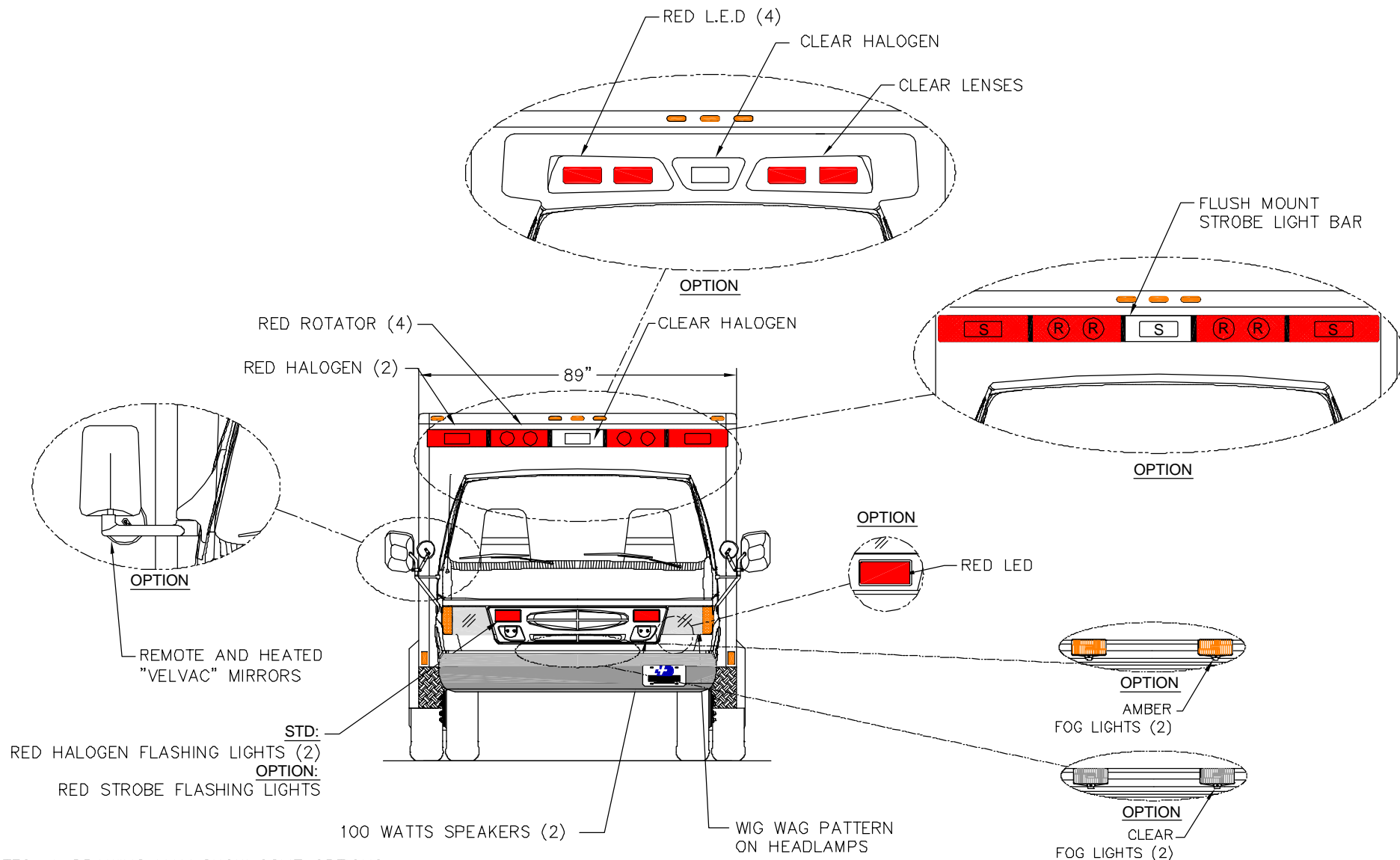
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31FD-E350XXX-B4-0082

REV.: 0 DATE: 12/04/04

# BOITE : B800601





NOTES: 1-DRAWING MAY SHOW SOME OPTIONS  
2-ELECTRIC DOOR LOCK ON ALL MODULE DOORS IN OPTION

DESCRIPTION : TYPE III – FRONT FACE VIEW

CONTRAT/CONTRACT :

*MYSTERE*

CHASSIS/FRAME  
FORD E350

ECH./SCALE  
1 : 40

MODELE/MODEL  
MX144E

PAGE  
1 / 1

DESS./DRAW. :  
YANNICK ADDY

VENT./SALES :  
DANIEL-C ROBITAILLE

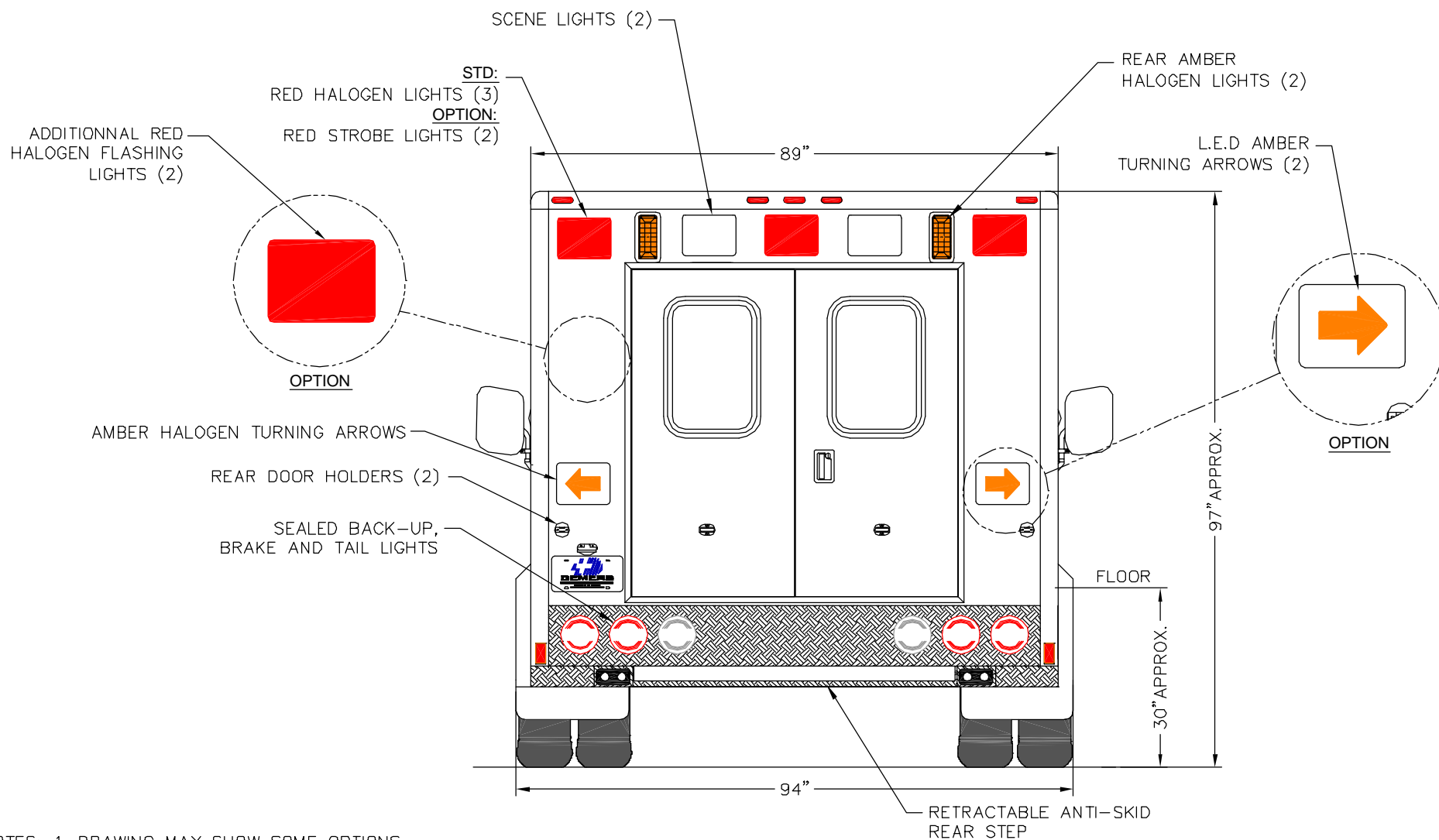
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SYLVAIN DEMERS

# DESSIN / DRAWING NO.

31FD-E350XXX-B4-0083

REV.: 0 DATE: 12/04/04

# BOITE : B800601



NOTES: 1-DRAWING MAY SHOW SOME OPTIONS  
2-ELECTRIC DOOR LOCK ON ALL MODULE DOORS IN OPTION

DESCRIPTION : TYPE III – REAR END VIEW

CONTRAT/CONTRACT :

*MYSTERE*

CHASSIS/FRAME  
FORD E350

ECH./SCALE  
1 : 25

MODELE/MODEL  
MX144E

PAGE  
1 / 1

DESS./DRAW. :  
YANNICK ADDY

VENT./SALES :  
DANIEL-C ROBITAILLE

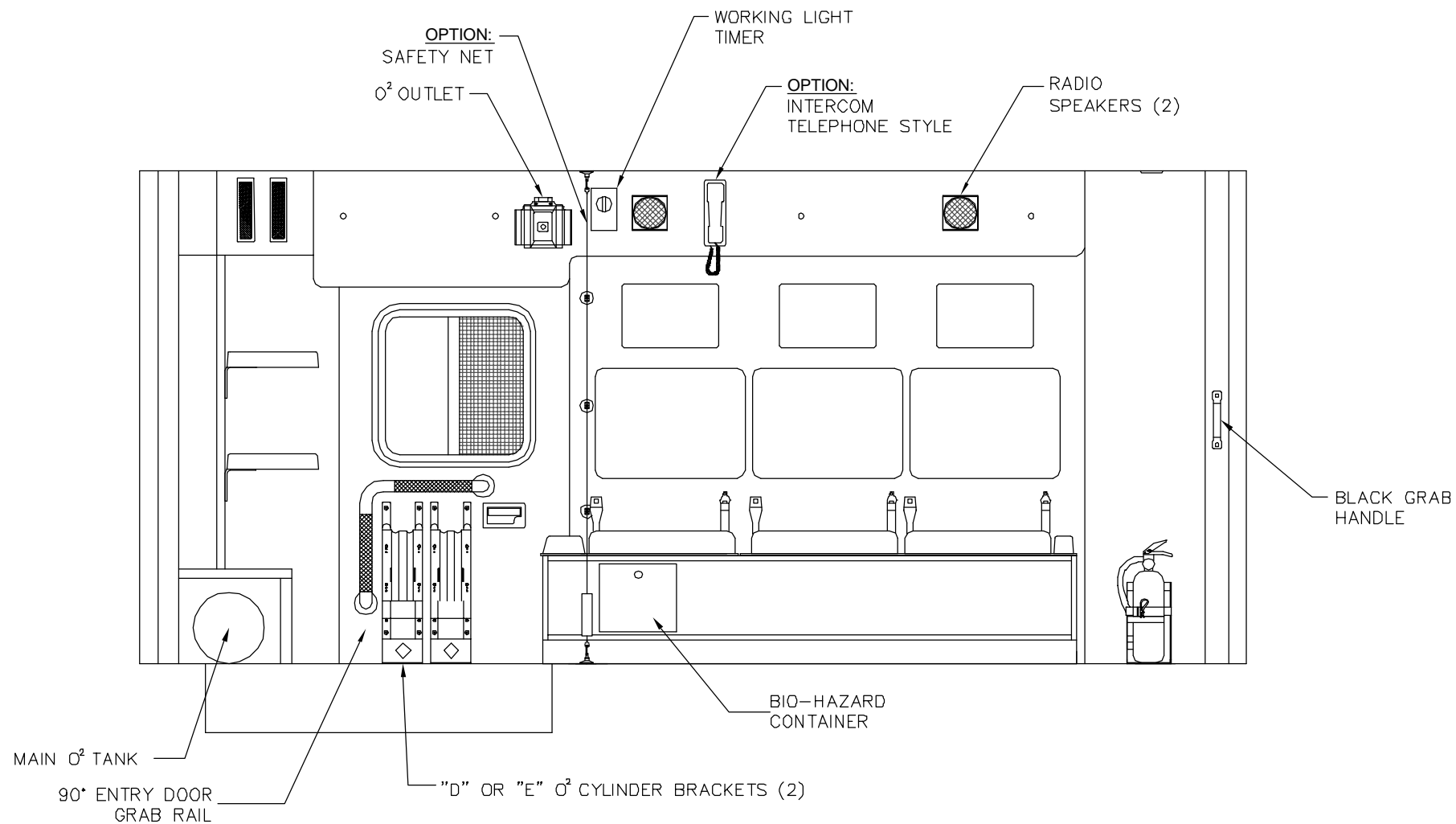
INGEN./ENGIN. :  
SYLVAIN DEMERS

# DESSIN / DRAWING NO.

31FD-E350XXX-B4-0084

REV.: 0 DATE: 12/04/04

# BOITE : B800601



NOTE: 1-DRAWING MAY SHOW SOME OPTIONS

DESCRIPTION : TYPE III - RIGHT WALL - SINGLE MAIN COT CONFIG.

CONTRAT/CONTRACT :

*MYSTERE*

CHASSIS/FRAME  
FORD E350

ECH./SCALE  
1 : 20

MODELE/MODEL  
MX144E

PAGE  
1 / 1

DESS./DRAW. :  
YANNICK ADDY

VENT./SALES :  
DANIEL-C ROBITAILLE

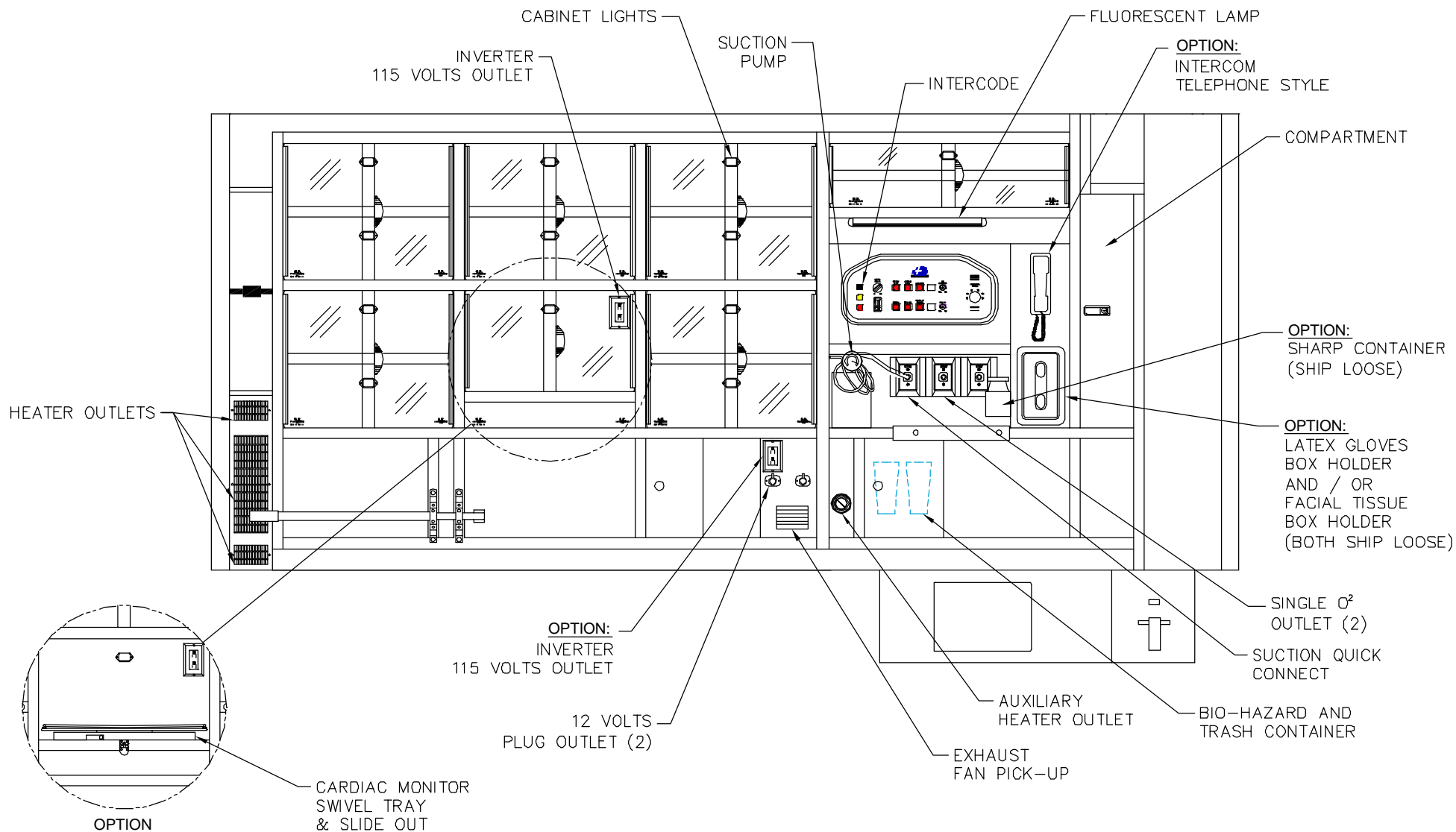
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SYLVAIN DEMERS

# DESSIN / DRAWING NO.

31FD-E350XXX-B4-0085

REV.: 0 DATE: 12/04/04

# BOITE : B800601



NOTE: 1-DRAWING MAY SHOW SOME OPTIONS

DESCRIPTION : TYPE III - LEFT WALL VIEW

CONTRAT/CONTRACT :

*MYSTERE*

CHASSIS/FRAME  
FORD E350

ECH./SCALE  
1 : 20

MODELE/MODEL  
MX144E

PAGE  
1 / 1

DESS./DRAW. :  
YANNICK ADDY

VENT./SALES :  
DANIEL-C ROBITAILLE

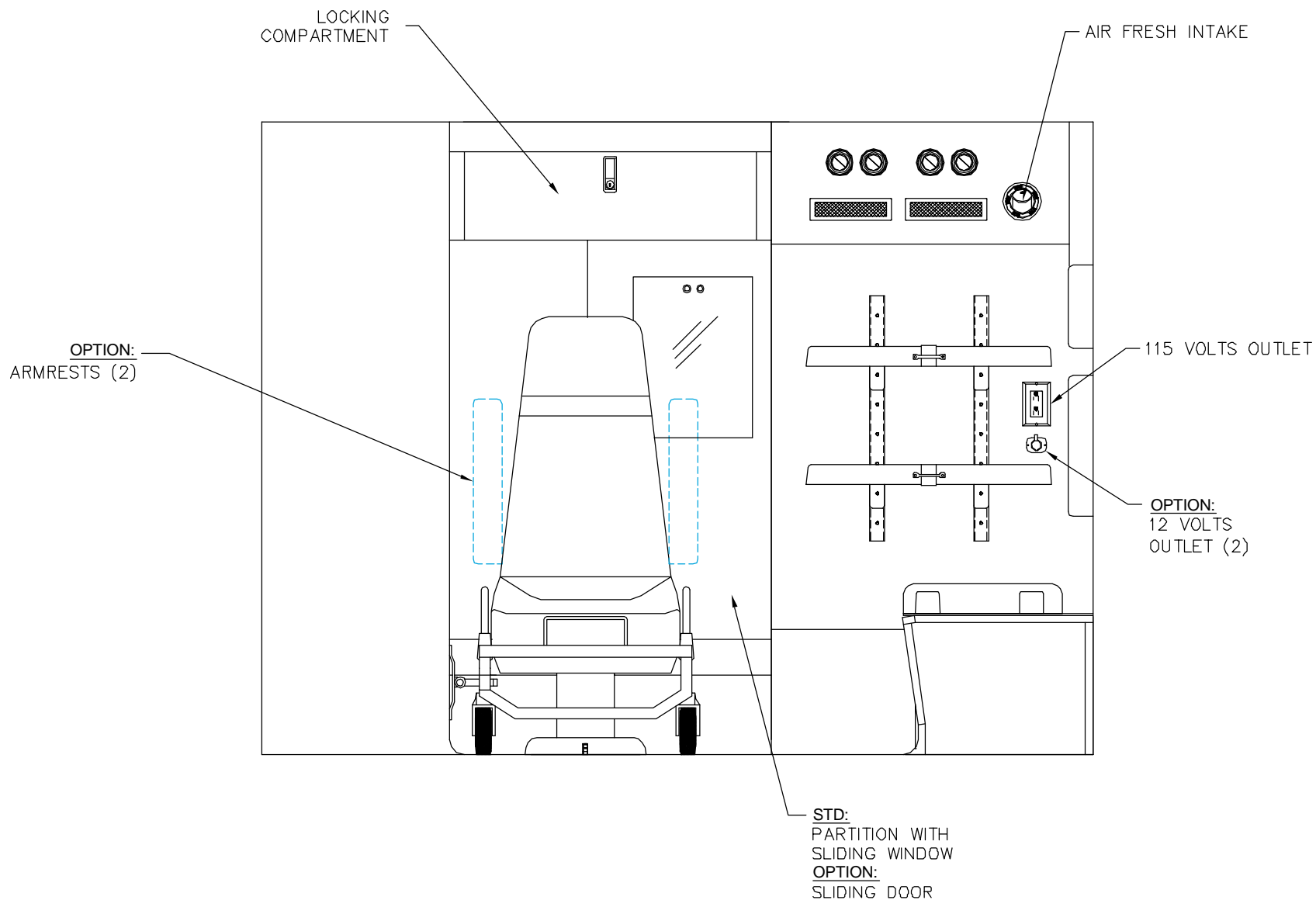
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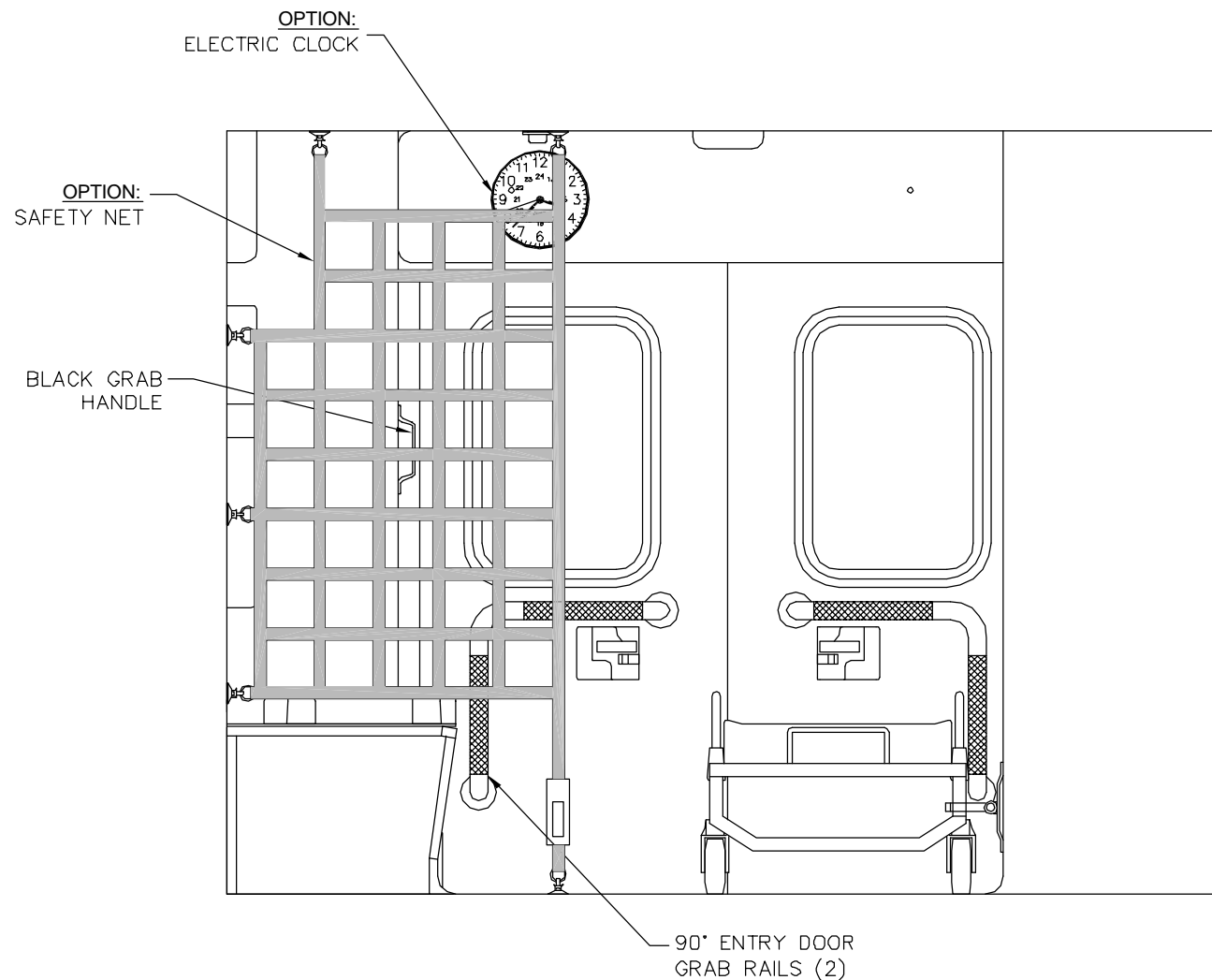
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# BOITE : B800601




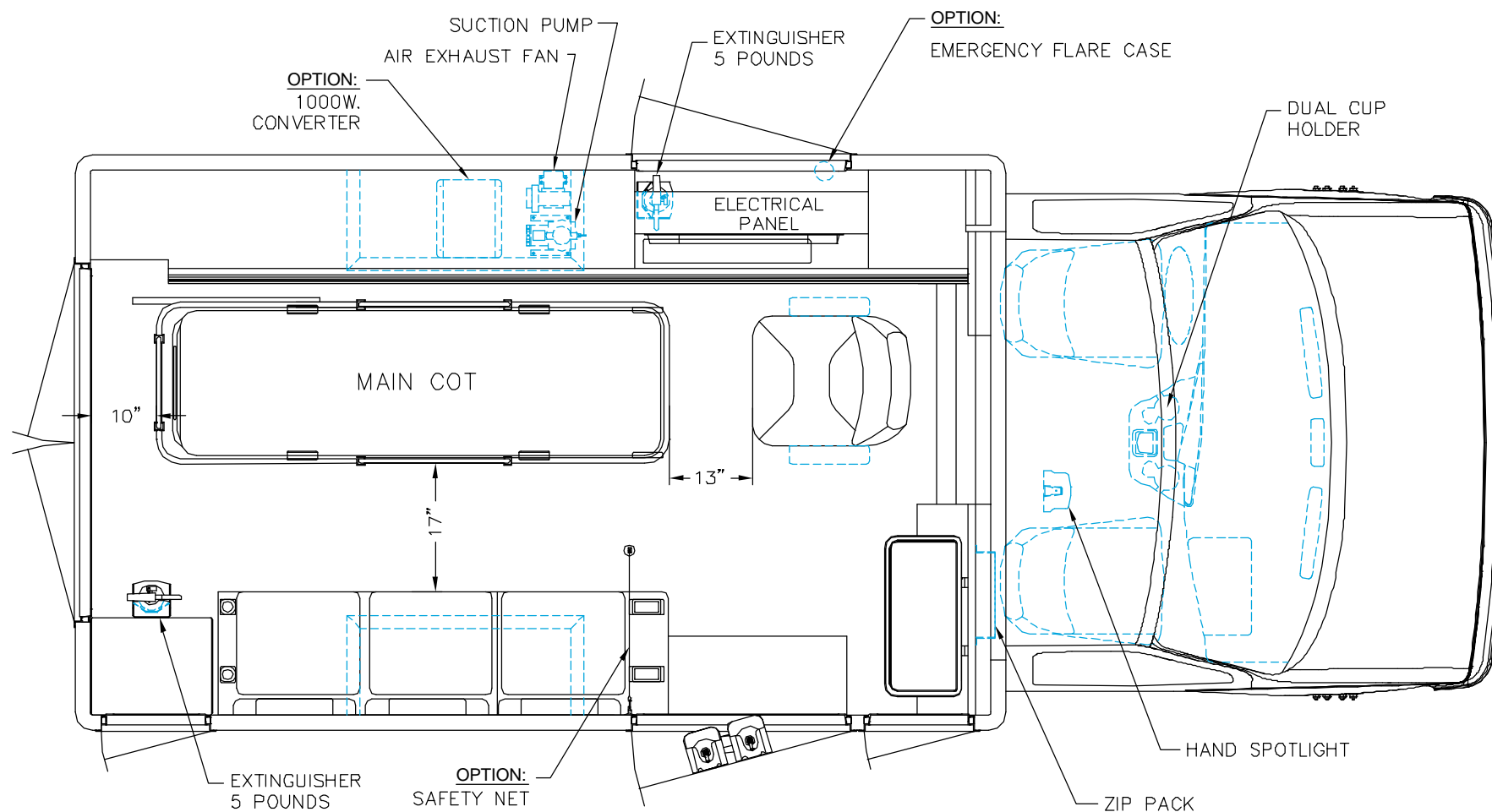
NOTE: 1-DRAWING MAY SHOW SOME OPTIONS

 <b>DEMERS</b> AMBULANCES www.demers-ambulances.com	DESCRIPTION : TYPE III – FRONT WALL – SINGLE MAIN COT				# DESSIN / DRAWING NO.	
	CONTRAT/CONTRACT :  <i>MYSTERE</i>	CHASSIS/FRAME FORD E350	MODELE/MODEL MX144E	DESS./DRAW. : YANNICK ADDY	31FD-E350XXX-B4-0088	
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				INGEN./ENGIN. : SYLVAIN DEMERS	# BOITE : B800601	



NOTE: 1-DRAWING MAY SHOW SOME OPTIONS

	DESCRIPTION : TYPE III – REAR WALL – SINGLE MAIN COT			# DESSIN / DRAWING NO.	
	CONTRAT/CONTRACT :	CHASSIS/FRAME	MODELE/MODEL	DESS./DRAW. :	31FD-E350XXX-B4-0090
		FORD E350	MX144E	YANNICK ADDY	
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	<i>MYSTERE</i>	1 : 15	1 / 1	DANIEL-C ROBITAILLE	
				INGEN./ENGIN. :	# BOITE : B800601
				SYLVAIN DEMERS	



NOTE: 1-DRAWING MAY SHOW SOME OPTIONS

DESCRIPTION : YPE III – FLOOR VIEW – SINGLE MAIN COT

CONTRAT/CONTRACT :

*MYSTERE*

CHASSIS/FRAME  
FORD E350

ECH./SCALE  
1 : 25

MODELE/MODEL  
MX144E

PAGE  
1 / 1

DESS./DRAW. :  
YANNICK ADDY

VENT./SALES :  
DANIEL-C ROBITAILLE

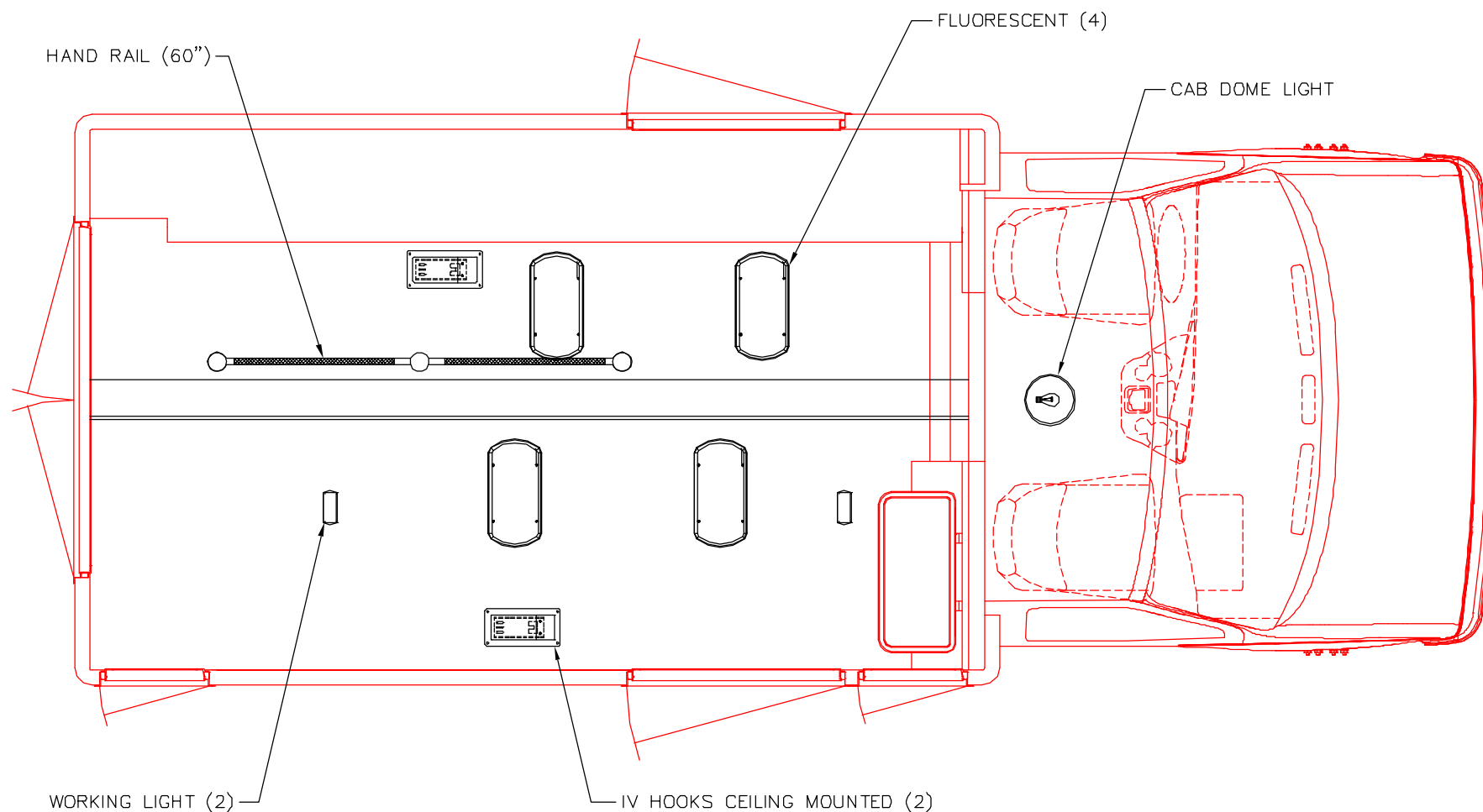
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SYLVAIN DEMERS

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31FD-E350XXX-B4-0092

REV.: 0 DATE: 12/04/04

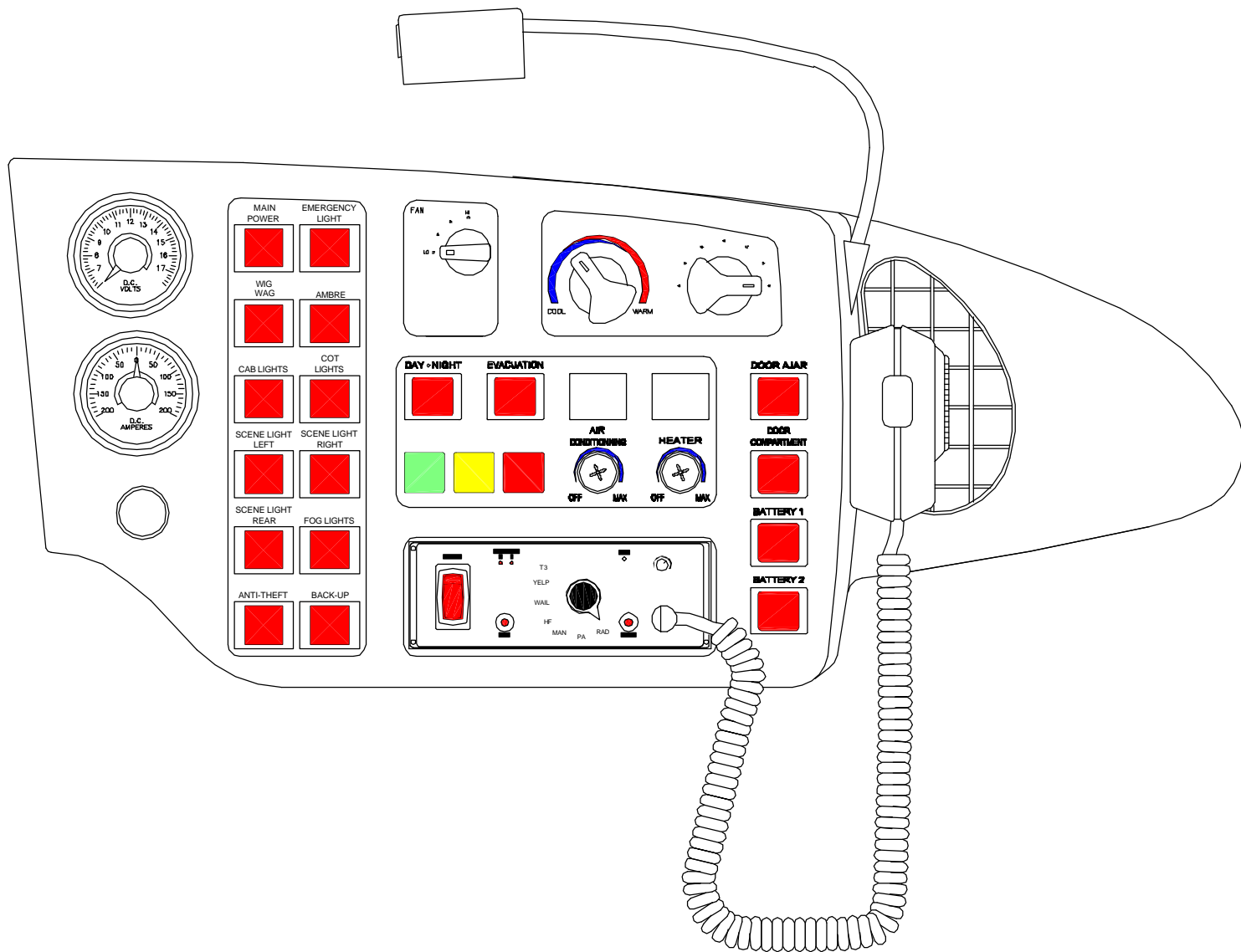
# BOITE : B800601



NOTE: 1-DRAWING MAY SHOW SOME OPTIONS

	DESCRIPTION : TYPE III – INTERIOR LIGHT LOCATION				# DESSIN / DRAWING NO.	
	CONTRAT/CONTRACT :	CHASSIS/FRAME	MODELE/MODEL	DESS./DRAW. :	31FD-E350XXX-B4-0094	
		FORD E350	MX144E	YANNICK ADDY		
		ECH./SCALE	PAGE	VENT./SALES :	REV.: 0	DATE: 12/04/04
	<i>MYSTERE</i>	1 : 25	1 / 1	DANIEL-C ROBITAILLE	# BOITE : B800601	
				INGEN./ENGIN. : SYLVAIN DEMERS		





DESCRIPTION : TYPE II – FRONT CONSOLE

CONTRAT/CONTRACT :

*MYSTERE*

CHASSIS/FRAME  
FORD E350

ECH./SCALE  
NTS

MODELE/MODEL  
MX144E

PAGE  
1 / 1

DESS./DRAW. :  
YANNICK ADDY

VENT./SALES :  
DANIEL-C ROBITAILLE

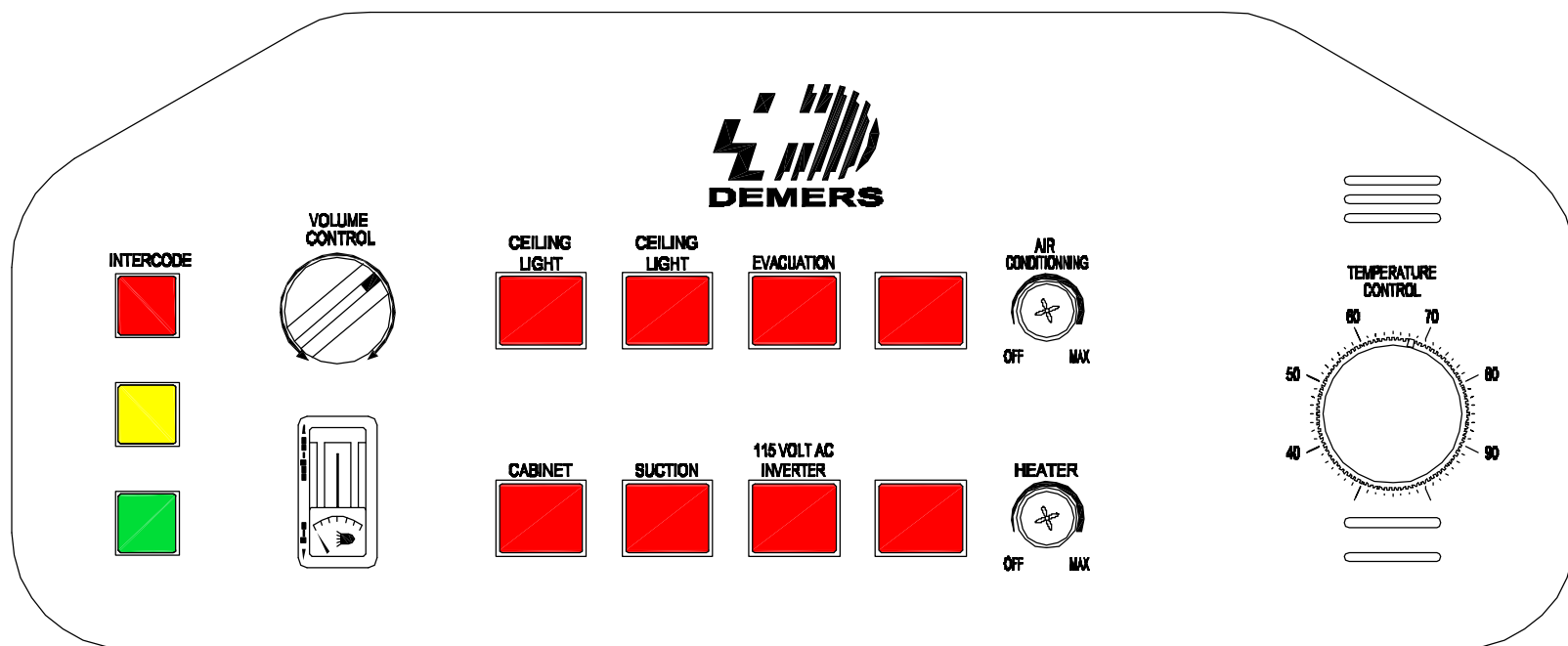
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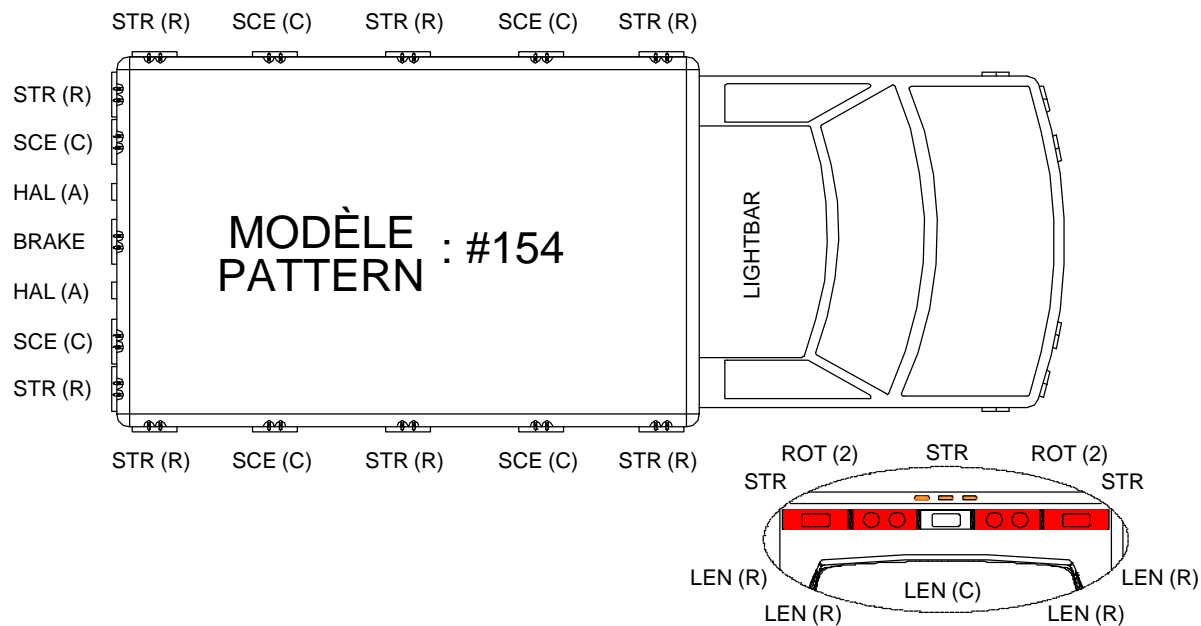
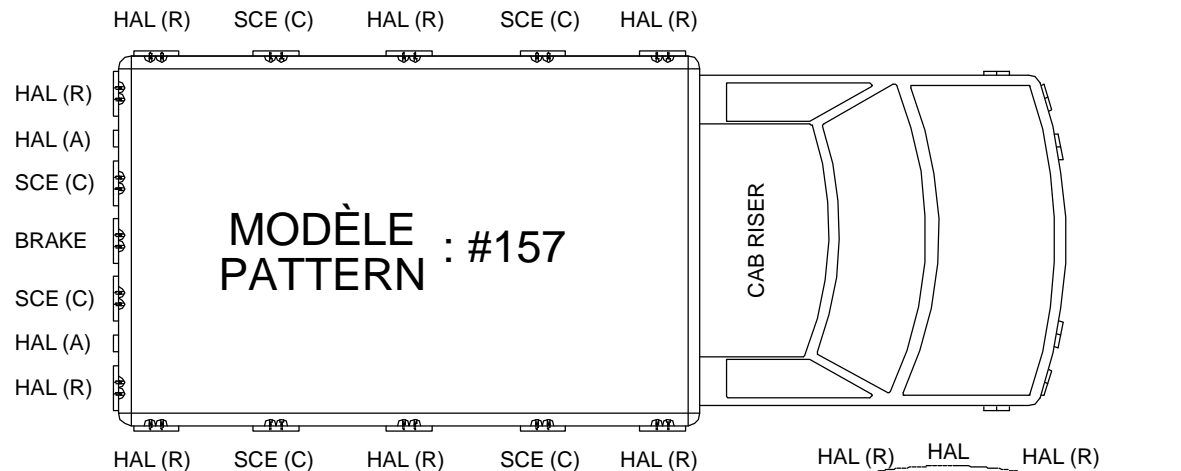
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REV.: 0 DATE: 12/04/04

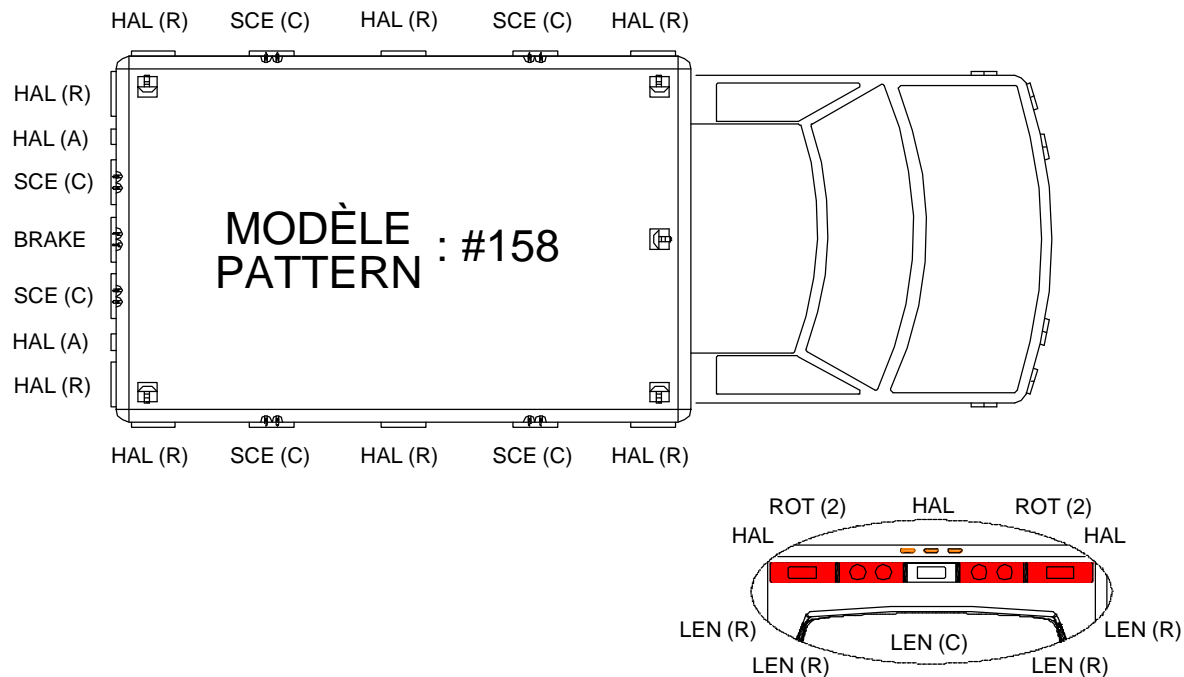
# BOITE : B800601




LEGEND	
ROT	- ROTATOR
HAL	- HALOGEN LIGHT
STR	- STROBE LIGHT
SCE	- SCENE LIGHT
BRAKE	- HIGH MOUNTED STOP LAMP
LEN	- LENS
(R)	- RED COLOR
(C)	- CLEAR COLOR
LED	- LIGHT EMITTING DIODE
(A)	- AMBER COLOR
EXAMPLE	
ROT (R) : ONE ROTATOR WITH A RED LENS	



LEGEND	
ROT	- ROTATOR
HAL	- HALOGEN LIGHT
STR	- STROBE LIGHT
SCE	- SCENE LIGHT
BRAKE	- HIGH MOUNTED STOP LAMP
LEN	- LENS
(R)	- RED COLOR
(C)	- CLEAR COLOR
LED	- LIGHT EMITTING DIODE
(A)	- AMBER COLOR
EXAMPLE	
ROT (R) : ONE ROTATOR WITH A RED LENS	



 <b>DEMERS</b> AMBULANCES www.demers-ambulances.com	DESCRIPTION : TYPE III – LIGHT PATTERN				# DESSIN / DRAWING NO.		
	CONTRAT/CONTRACT :  <i>MYSTERE</i>	CHASSIS/FRAME FORD E350	MODELE/MODEL MX144E	DESS./DRAW. : YANNICK ADDY	Z 0 0 0 0 2 2 7		
		ECH./SCALE 1 : 35	PAGE 2 / 2	VENT./SALES : DANIEL – C ROBITAILLE			REV.: 0
					INGEN./ENGIN. : SYLVAIN DEMERS	# BOITE : B800601	

# Federal Specification for the Star-of-Life Ambulance



**KKK-A-1822F**  
**August 1, 2007**

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# 1. SCOPE, PURPOSE, AND CLASSIFICATION

## 1.1 SCOPE.

This specification identifies the minimum requirements for new automotive Emergency Medical Services (EMS) ambulances (except military field ambulances) built on Original Equipment Manufacturer's Chassis (OEM) that are prepared by the OEM for use as an ambulance.

The ambulances are front or rear wheel driven (4x2) and minimally warranted as specified in Section 6.

Refurbishing and remounted vehicles are not covered by this standard. This standard applies to new vehicles only.

By definition an ambulance is a vehicle used for emergency medical care and patient transport. This specification is for the construction of ambulances, not for vehicles intended for use as fire apparatus. National and international standards exist for automotive fire apparatus. These standards can be obtained from organizations such as the National Fire Protection Association (NFPA).

Section 3 of this specification contains:

- Optional configurations.
- A worksheet to assist the purchaser in developing their procurement requirements.

### 1.1.1 DEFINITION OF AMBULANCE.

The ambulance is defined as a vehicle used for emergency medical care that provides:

- A driver's compartment.
- A patient compartment to accommodate an emergency medical services provider (EMSP) and one patient located on the primary cot so positioned that the primary patient can be given intensive life-support during transit.
- Equipment and supplies for emergency care at the scene as well as during transport.
- Safety, comfort, and avoidance of aggravation of the patient's injury or illness.
- Two-way radio communication.
- Audible and Visual Traffic warning devices.

### 1.1.2 PURPOSE.

The purpose of this document is to describe ambulances that are authorized to display the "Star of Life" symbol. It establishes minimum specifications, performance parameters and essential criteria for the design of ambulances and to provide a practical degree of standardization. The object is to provide ambulances that are nationally recognized, properly constructed, easily maintained, and, when professionally staffed and provisioned, will function reliably in pre-hospital or other mobile emergency medical service.

### **1.1.3 “STAR OF LIFE” CERTIFICATION.**

The final stage ambulance manufacturer (FSAM) shall furnish to a purchaser an authenticated certification and label stating that the ambulance and equipment comply with this specification and applicable change notices in effect on the date the ambulance is contracted for. FSAMs making this certification are permitted to use the “Star of Life” symbol to identify an ambulance as compliant with the Federal specifications for ambulances. Use of the symbol must be in accordance with the purpose and use criteria set forth in published guidelines (Document Number DOT HS 808 721, Rev. June 1995) by the National Highway Traffic Safety Administration, an operating administration of the U.S. Department of Transportation.



## 2. APPLICABLE DOCUMENTS

### 2.1 **THE FOLLOWING STANDARDS AND REGULATIONS FORM A PART OF THIS SPECIFICATION, TO THE EXTENT SPECIFIED OR REQUIRED BY LAW. UNLESS A SPECIFIC ISSUE OF A STANDARD OR REGULATION IS IDENTIFIED, THE ISSUE IN EFFECT, ON THE DATE THE AMBULANCE IS CONTRACTED FOR, SHALL APPLY.**

#### **FEDERAL SPECIFICATIONS:**

RR-C-901C — CYLINDERS, COMPRESSED GAS: HIGH PRESSURE, STEEL DOT 3AA AND ALUMINUM APPLICATIONS

#### **FEDERAL STANDARDS:**

Federal Standard No. 297 — Rustproofing of Commercial (Nontactical) Vehicles

#### **MILITARY STANDARDS:**

MIL-STD-461 Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment.

MIL-STD-1223 Non-tactical Wheeled Vehicles, Painting, Identification Marking, and Data Plate Standards.

#### **LAWS AND REGULATIONS:**

29 CFR 1910.1030: Blood borne Pathogens

29 CFR 1910.7 Definition and Requirements for a Nationally Recognized Testing Laboratory

21 CFR 820: Quality System Regulation

40 CFR 86: Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines.

47 CFR, PART 90: Public Safety Radio Services (FCC)

49 CFR 393: Federal Motor Carrier Safety Regulations (FMCSR)

49 CFR 571: Federal Motor Vehicle Safety Standards (FMVSS)

### 2.2 **OTHER PUBLICATIONS.**

The following documents form a part of this specification to the extent specified. Unless a specific issue is identified, the issue in effect, on the date the ambulance is contracted for, shall apply.

#### **THE TIRE AND RIM ASSOCIATION, INC.**

Yearbook

#### **NATIONAL FIRE PROTECTION ASSOCIATION**

70 – National Electric Code

1901 – Standard for Automotive Fire Apparatus

**SOCIETY OF AUTOMOTIVE ENGINEERS (SAE), INC., STANDARDS, AND  
RECOMMENDED PRACTICES:**

J163 Low Tension Wiring and Cable Terminals and Splice Clips  
J537 Storage Batteries  
J541 Voltage Drop for Starting Motor Circuits  
J553 Circuit Breakers  
J561 Electrical Terminals, Eyelet, and Spade Type  
J575 Tests for Motor Vehicle Lighting Devices & Components  
J576 Plastic Materials, For Use In Optical Parts Such As Lenses and Reflectors of Motor Vehicle Lighting Devices  
J578 Color Specification for Electric Signal Lighting Devices  
J595 Flashing Warning Lamps for Authorized Emergency, Maintenance, and Service Vehicles  
J638 Test Procedure and Ratings for Hot Water Heaters for Motor Vehicles  
J639 Safety Practices for Mechanical Vapor Compression Refrigeration Equipment or Systems Used To Cool Passenger Compartment of Motor Vehicles  
J689 Approach, Departure, and Ramp Break over Angles  
J682 Rear Wheel Splash and Stone Throw Protection  
J683 Tire Chain Clearance  
J858 Electrical Terminals, Blade Type  
J928 Electrical Terminals, Pin, and Receptacle Type  
J994 Backup Alarms, Performance Test and Application  
J1054 Warning Lamp, Alternating Flashers  
J1127 Battery Cable  
J1128 Low Tension Primary Cable  
J1292 Automobile, Truck, Truck-Tractor, Trailer, and Motor Coach Wiring  
J1349 Engine Power Test Code, Spark Ignition and Diesel  
J1318 Strobe Warning Lights  
J2498 Minimum Performance of the Warning Light System Used on Emergency Vehicles

**NATIONAL TRUCK EQUIPMENT ASSOCIATION / AMD:**

AMD STANDARD 001 – AMBULANCE BODY STRUCTURE STATIC LOAD TEST  
AMD STANDARD 002 – BODY DOOR RETENTION COMPONENTS TEST  
AMD STANDARD 003 – OXYGEN TANK RETENTION SYSTEM STATIC TEST  
AMD STANDARD 004 – LITTER RETENTION SYSTEM STATIC TEST  
AMD STANDARD 005 – 12-VOLT DC ELECTRICAL SYSTEM TEST  
AMD STANDARD 006 – PATIENT COMPARTMENT SOUND LEVEL TEST  
AMD STANDARD 007 – PATIENT COMPARTMENT CARBON MONOXIDE LEVEL TEST  
AMD STANDARD 008 – PATIENT COMPARTMENT GRAB RAIL STATIC LOAD TEST  
AMD STANDARD 009 – 125V AC ELECTRICAL SYSTEMS TEST  
AMD STANDARD 010 – WATER SPRAY TEST  
AMD STANDARD 011 – EQUIPMENT TEMPERATURE TEST  
AMD STANDARD 012 – INTERIOR CLIMATE CONTROL TEST  
AMD STANDARD 013 – WEIGHT DISTRIBUTION GUIDELINES  
AMD STANDARD 014 – ENGINE COOLING SYSTEM TEST  
AMD STANDARD 015 – AMBULANCE MAIN OXYGEN SYSTEM TEST  
AMD STANDARD 016 – PATIENT COMPARTMENT LIGHTING LEVEL TEST  
AMD STANDARD 017 – ROAD TEST

AMD STANDARD 018 – REAR STEP AND BUMPER STATIC LOAD TEST  
AMD STANDARD 019 – MEASURING GUIDELINES: CABINETS & COMPARTMENTS  
AMD STANDARD 020 – FLOOR DISTRIBUTED LOAD TEST  
AMD STANDARD 021 – ASPIRATOR SYSTEM TEST, PRIMARY PATIENT  
AMD STANDARD 022 – COLD ENGINE START TEST  
AMD STANDARD 023 – SIREN PERFORMANCE TEST  
AMD STANDARD 024 – PERIMETER ILLUMINATION TEST  
AMD STANDARD 025 – MEASURING GUIDELINES: OCCUPANT HEAD CLEARANCE ZONES

**AMERICAN COLLEGE OF EMERGENCY PHYSICIANS (ACEP):**

Guidelines for Ambulance Equipment

**AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

F 920 Standard Specification for Minimum Performance and Safety Requirements for Resuscitators Intended for Use with Humans  
F 960 Standard Specification for Medical and Surgical Suction and Drainage Systems  
D 4956 Standard Specification for Retroreflective Sheeting for Traffic Control  
D6210 Standard Specification for Fully-Formulated Glycol Base Engine Coolant for Heavy-Duty Engines  
B117 Standard Practice for Operating Salt Spray (Fog) Apparatus  
IPC-610D Acceptability of Electronic Assemblies

**NATIONAL EMSC (EMERGENCY MEDICAL SERVICES FOR CHILDREN)**

**RESOURCE ALLIANCE:**

COMMITTEE ON AMBULANCE EQUIPMENT AND SUPPLIES

Guidelines for pediatric equipment and supplies for Basic and Advanced life support ambulances

**AUTOMOTIVE MANUFACTURERS EQUIPMENT COMPLIANCE AGENCY(AMECA):**

Approval of Motor Vehicle Safety Equipment (emergency lights and sirens)

**AMERICAN NATIONAL STANDARDS INSTITUTE:**

Z535.1 American National Standard for Safety Colors

*For assistance in obtaining the referenced documents, contact the Department of Commerce, National Technical Information Service (NTIS).*

## **2.3 ORDER OF PRECEDENCE.**

In the event of a conflict between the text of this specification and the references cited, the text of this specification shall take precedence.

# 3. REQUIREMENTS

## 3.1 GENERAL VEHICULAR DESIGN, TYPES, AND CONFIGURATION.

### 3.1.1 DESIGN.

The ambulance and the allied equipment furnished under this specification shall be the OEM's current model year commercial vehicle of the Type and Configuration specified. The ambulance shall be complete with the operating accessories, as specified. The design of the vehicle and the specified equipment shall permit accessibility for servicing, replacement, and adjustment of component parts and accessories with minimum disturbance to other components and systems. The term "heavy-duty," as used to describe an item, shall mean in excess of the standard quantity, quality, or capacity and represents the best, most durable, strongest, etc., part, component, system, etc., that is commercially available on the OEM chassis.

### 3.1.2 TYPE I AMBULANCE (10,001 TO 14,000 GVWR).

Type I vehicle shall be a cab chassis furnished with a modular ambulance body.

### 3.1.2.1 TYPE I - AD (ADDITIONAL DUTY) AMBULANCE (14,001 GVWR OR MORE).

Type I-AD shall be a Cab-Chassis with modular ambulance body, increased GVWR, storage, and payload.

### 3.1.3 TYPE II AMBULANCE (9201 – 10,000 GVWR).

Type II ambulance shall be a long wheelbase Van, with Integral Cab-Body.

### 3.1.4 TYPE III AMBULANCE (10,001 TO 14,000 GVWR).

Type III shall be a Cutaway Van with integrated modular ambulance body.

### 3.1.4.1 TYPE III- AD (ADDITIONAL DUTY) AMBULANCE (14,001 GVWR OR MORE).

Type III-AD shall be a Cutaway Van with integrated modular body, and increased GVWR, storage, and payload.

### 3.1.5 CONFIGURATION OF PATIENT COMPARTMENT.

Primary cot shall be loaded to position the patient's head forward in the ambulance. The primary cot shall be mounted to provide maximum access from the EMSP seat.

## 3.2 VEHICLE, AMBULANCE COMPONENTS, EQUIPMENT, AND ACCESSORIES.

The emergency medical care vehicles; including chassis, ambulance body, equipment, devices, medical accessories, and electronic equipment shall be standard commercial products, tested and certified to meet or exceed the requirements of this specification. The ambulance shall comply with all Federal Motor Vehicle Safety Standards (FMVSS) and other Federal and state regulations applicable or specified for the year of manufacture. The chassis, components, and optional items shall be as rep-

resented in the OEM's current technical data. The ambulance body, equipment, and accessories shall be as represented in their respective FSAM's current technical data. The FSAM shall provide total standardization and interchangeability between similar vehicles, equipment, items, and accessories specified for all ambulance units under each contract.

### **3.2.1 MEDICAL DEVICES.**

All medical devices furnished must be marketed in compliance with Food and Drug Administration (FDA) regulatory requirements.

## **3.3 RECOVERED MATERIALS.**

All equipment, material, and articles required under this specification are to be new or fabricated from new materials produced from recovered materials. The term "recovered materials" means materials that have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed.

## **3.4 VEHICLE OPERATION, PERFORMANCE, AND PHYSICAL CHARACTERISTICS.**

### **3.4.1 OPERATION AND PERFORMANCE.**

All requirements in Section 3.4 shall be met with the ambulance loaded at curb weight plus total usable payload. The vehicle shall be capable of operating safely and efficiently under the environmental conditions outlined.

### **3.4.2 TEMPERATURE CONDITIONS.**

#### **3.4.2.1 EXTERIOR.**

The ambulance and equipment shall be operable in ambient temperature ranging from 0°F to 95°F.

#### **3.4.2.2 INTERIOR.**

The interior of the ambulance patient compartment must be maintained at a minimum temperature of 50°F when the ambulance is prepared for immediate response. This requirement does not apply to ambulances that are fully operational but being held in reserve or ambulances that are not fully operational.

### **3.4.3 NOISE AND SOUND LEVEL LIMITS, EXTERIOR.**

Unless more stringent sound levels are regulated by the states and municipalities where the ambulance will be based, the exterior noise level produced by the vehicle, except siren, shall not exceed federal regulations.

### **3.4.4 VEHICLE PERFORMANCE.**

The ambulance shall provide a smooth, stable ride. When available from the OEM, automatic vehicle stability control (AVSC) shall be furnished.

#### **3.4.5 SPEED.**

The vehicles shall be capable of a sustained speed of not less than 65 mph over dry, hard surfaced, level roads, at sea level, and passing speeds of 70 mph when tested under normal ambient conditions.

#### **3.4.6 ACCELERATION.**

Vehicle shall have a minimum average acceleration, at sea level, of 0-55 mph within 25 seconds. Test shall be performed under normal ambient conditions.

#### **3.4.7 GRADEABILITY.**

The vehicle shall be capable of meeting the following performance requirements. The determination shall be made by actual test or OEM's certified computer prediction.

##### **3.4.7.1 GRADEABILITY AT SPEED.**

Minimum gradeability at speed shall be 55 mph on a 3% (1.72°) grade.

##### **3.4.7.2 MINIMUM LOW SPEED GRADEABILITY.**

The minimum low speed gradeability shall be 5 mph on a 35% (19.3°) grade.

#### **3.4.8 FUEL RANGE.**

The ambulance shall be capable of being driven for at least 250 miles without refueling.

#### **3.4.9 FORDING.**

The vehicle shall be capable of three fordings, without water entering patient and equipment compartments while being driven through a minimum of 8" of water, at speeds of 5 mph, for a distance of at least 100'.

#### **3.4.10 VEHICLE PHYSICAL DIMENSIONAL REQUIREMENTS.**

##### **3.4.10.1 LENGTH.**

Overall length of the ambulance (OAL) shall be specified by the purchaser, including bumpers, rear step and bumper guards.

##### **3.4.10.2 WIDTH.**

The overall width of ambulance bodies having dual rear wheels shall be a maximum of 96", excluding mirrors, lights, and other safety appurtenances.

The ambulance body sides, on a chassis with dual rear wheels, shall be symmetrical and within +/- 2.5" of the overall width of the tires (outside sidewalls). The 2.5" allowance is not cumulative; it applies individually to each side. Tires shall not extend beyond the fenders.

##### **3.4.10.3 HEIGHT.**

The purchaser shall specify the overall height of the ambulance when loaded to curb weight. This includes roof-mounted equipment, but excludes two-way radio antenna(s).

#### **3.4.10.4 ANGLE OF APPROACH, RAMP BREAKOVER AND DEPARTURE.**

With the exception of the OEM's furnished and installed components, the ambulance shall provide not less than the following clearance, measured in accordance with SAE J689.

Approach angle 20°

Ramp breakover 10°

Departure angle 10°

#### **3.4.10.5 TURNING RADIUS.**

Turning radius shall not be greater than the OEM standard.

#### **3.4.10.6 FLOOR HEIGHT.**

The finished floor (loading) height shall be a maximum of 34".

### **3.5 VEHICLE WEIGHT RATINGS AND PAYLOAD.**

#### **3.5.1 CURB WEIGHT.**

Non-permanently mounted equipment is considered to be part of the payload, not the curb weight.

#### **3.5.2 PAYLOAD CAPACITY.**

Each ambulance's payload capacity shall be determined by completing the payload calculation form in Figure 2. The payload value of Figure 2, item 9 shall be displayed on the certification and payload signage as shown in Figure 1. The label shall be located in a conspicuous location in the ambulance.

The required minimum payload per vehicle without optional equipment shall be as follows:

1. Single rear wheeled, van ambulances (Type II)—1500 lbs.
2. Dual rear wheeled, modular ambulances (Type I or III)—1750 lbs.
3. Additional duty modular ambulances (Type I AD or III AD)—2,250 lbs.

The ambulance shall not be operated in an overloaded condition. EMSPs should determine that the actual load, to be placed on the vehicle, does not exceed the total usable payload as manufactured. Any additional items attached to, or carried on the vehicle by the EMSP will reduce the combined weight of occupants and cargo that comprise the total usable payload.

Additional weight added, resulting from specified options, will reduce the available minimum payload per vehicle.

Occupant weight shall be accommodated at 150 lbs. for each designated seating position and the primary patient.

### FIGURE 1 – Certification & Payload Signage

The label shall be mounted on the body (module) interior in a conspicuous location.

- The label shown here is suggested format.
- Deviations in dimensions are acceptable.
- All text must be included.

CERTIFIED "STAR OF LIFE" AMBULANCE	
Date of Manufacture	_____
Mfg By	_____
Address	_____
City	_____ State _____ Zip _____
This ambulance conforms to Federal Specification KKK-A-1822 in effect on the date the ambulance was contracted for.	
Final Stage Ambulance Manufacturers ID Number	_____
VIN	_____
OEM Chassis Model, Year of Manufacture	_____
Vehicle Type	_____
<b>NOTICE: THIS VEHICLE, AS MANUFACTURED, CONFORMS TO THE PAYLOAD REQUIREMENTS OF THE FEDERAL AMBULANCE SPECIFICATION KKK-A-1822. USERS SHALL NOT LOAD VEHICLES ABOVE THE GVWR, GAWRs OR EXCEED THE TOTAL USABLE PAYLOAD LISTED BELOW.</b>	
TOTAL USABLE PAYLOAD	_____ lbs.
(TOTAL REMAINING WEIGHT CAPACITY OF OCCUPANTS AND CARGO USER MAY ADD)	

### FIGURE 2 – Payload Calculation Form

The completed form shall be included in the handbook of instructions.

- The form shown here is suggested format.
- Deviations in dimensions are acceptable.
- All text must be included.

CUSTOMER USABLE PAYLOAD INFORMATION	
Final Stage Ambulance Manufacturer's Name:	_____
OEM Chassis Year, Make, Model:	_____
1) Ambulance Model, Type, Prod. #:	_____
2) OEM GAWR – Front:	_____ lbs
3) OEM GAWR – Rear:	_____ lbs
4) OEM GVWR:	_____ lbs
5) Minimum Payload Per KKK-A-1822:	_____ lbs
6) Curb Weight – <b>AS BUILT</b> – Front Axle:	_____ lbs
7) Curb Weight – <b>AS BUILT</b> – Rear Axle:	_____ lbs
8) Total Curb Weight – <b>AS BUILT</b> :	_____ lbs
9) <b>CUSTOMER USABLE</b> Total Payload <b>AS BUILT</b> (item 4 minus item 8):	_____ lbs
10) <b>CUSTOMER USABLE</b> Front Axle Payload <b>AS BUILT</b> (item 2 minus item 6):	_____ lbs
11) Total Weight of Permanently mounted Options Specified (only required if item 9 does not meet or exceed item 5):	_____ lbs
12) Payload of Basic KKK Vehicle (item 9 plus item 11) (only required if item 9 does not meet or exceed item 5):	_____ lbs



### **3.5.3 GROSS VEHICLE WEIGHT RATING (GVWR).**

The combination of the vehicle's curb weight and total usable payload weight shall not exceed the ambulance GVWR.

### **3.5.4 WEIGHT DISTRIBUTION.**

Purchasers and FSAMs shall locate vehicle-mounted components, equipment, and supplies to provide a vehicle that is laterally balanced and within the GVWR and each gross axle weight rating (GAWR). The right and left wheel(s) of each axle of a completed ambulance shall be weighed to determine horizontal and lateral weight distribution. The weight distribution of a properly loaded ambulance on a level surface shall permit conformance to the FMVSS braking requirements in accordance with the statements provided by the OEM. All specifications and requirements for weight distribution and center of gravity of the OEM shall take precedence over the requirements contained in this section where the OEM's requirements are more restrictive or comprehensive.

- The weight between the right and left side of a given axle, when on a level surface, shall be within 5%.
- When loaded to the GVWR and within the GAWR for each axle, the front to rear weight distribution shall have not less than 20% of the total weight on the front axle, and not less than 50% nor more than 80% on the rear axle.
- The FSAM shall locate the center of gravity (CG) of the vehicle according to the requirements set by the OEM to determine and assure that the CG of the completed ambulance does not exceed any maximum horizontal and/or vertical limits.

To meet the above weight distribution requirements, consideration shall be given by the purchaser and FSAM to locate equipment and components to permit inherently proper lateral balance, front/rear axle loading, and center of gravity position.

### **3.5.5 RATINGS.**

Vehicle and component ratings shall be the OEM's published ratings and shall not be raised above the OEM's rating.

### **3.5.6 CAB TO AXLE (CA), TYPE I AND III VEHICLES.**

Cab to axle (CA) dimension of the vehicle chassis shall permit a minimum of 50% of the outside body length (including cab extensions) forward of the rear axle centerline, in addition to any cab to body clearance. Bodies designed with wheel openings shall have the rear wheels centered, within +/- 2" of those openings.

## **3.6 CHASSIS, POWER UNIT, AND COMPONENTS.**

### **3.6.1 CHASSIS-FRAME.**

The chassis shall include the OEM's ambulance preparation package when available. The chassis-frame and components shall be constructed to withstand the strains of on-off road service and any special service and equipment requirements specified. All chassis (including cab) components shall be as represented in the OEM's technical data.

### **3.6.2 VEHICLE LUBRICATION.**

The chassis components, devices, accessories, and added equipment requiring lubrication shall be fully equipped with lubrication fittings, as provided by the OEM or equipment manufacturer.

### **3.6.3 POWER UNIT, ENGINE.**

#### **3.6.3.1 POWER UNIT.**

The power unit shall meet or exceed the required vehicle performance specified at not more than the engine manufacturer's recommended operating engine speed. The OEM's diesel engine and power train shall be provided. The OEM's block heater shall also be furnished.

#### **3.6.3.2 ENGINE LOW TEMPERATURE STARTING.**

The engine shall start satisfactorily without the aid of engine block preheating devices (except glow plugs) or combustion air preheater at 0°F. The determination shall be made by actual test or OEM's certification.

### **3.6.4 POWER UNIT COMPONENTS.**

#### **3.6.4.1 OIL FILTER.**

The oil filter shall be the OEM's standard for the engine offered.

#### **3.6.4.2 AIR FILTER.**

The air filter shall be the OEM's standard for the engine offered.

#### **3.6.4.3 AIR POLLUTION CONTROL.**

Vehicles destined for the 50 states, the District of Columbia, Puerto Rico, the Virgin Islands, Guam and American Samoa shall comply with the Environmental Protection Agency (EPA) regulations governing Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines in effect on date of manufacture of the engine.

#### **3.6.4.4 FUEL SYSTEM.**

The fuel system shall conform to all applicable FMVSS, FMCSR, CARB, and EPA requirements.

The fuel system components shall be installed, connected, and routed in accordance with all OEM's guidelines. A permanent label at the fuel filler opening shall be furnished specifying the specific type of fuel required.

#### **3.6.4.5 COOLING SYSTEM.**

A coolant overflow recovery tank and compensating system shall be furnished. The cooling system shall be protected with an OEM solution of extended life antifreeze/coolant. Coolant to be the OEM's recommended type and mixture. The FSAM shall provide the OEM maximum size cooling system for the engine provided. The cooling system design shall maintain the engine at safe operating temperatures at all drivable altitudes and grades encountered during on and off road vehicle use.

#### **3.6.4.6 EXHAUST SYSTEM.**

The exhaust shall discharge at the vertical side(s) of the ambulance at a maximum distance of 1" beyond the side of the module and be angled /positioned to project the exhaust away from the door(s) to minimize fumes and contaminants entering the interior. On modular vehicles, the tailpipe outlet shall not terminate within 12" of the vertical axis of the fuel tank filler opening(s) when located on the same side. Modifications or extensions made to the OEM exhaust system shall meet or exceed OEM's requirements in terms of backpressure, components, design, and workmanship.

#### **3.6.5 DRIVE TRAIN.**

##### **3.6.5.1 DRIVE TRAIN COMPONENTS.**

The drive train and component's torque capacity shall meet or exceed the maximum torque developed in the lowest gear ratio by the engine.

##### **3.6.5.2 AUTOMATIC TRANSMISSION.**

The OEM's automatic transmission shall be provided. The transmission shall provide not less than four speeds forward and one reverse and shall be equipped with the OEM's heaviest duty transmission fluid cooler.

##### **3.6.5.3 DRIVELINE.**

The driveline (driveshaft, U-joints, etc.) shall be balanced and supported to perform throughout the design speed range without whipping or vibrating.

##### **3.6.5.4 BRAKE SYSTEMS, SERVICE AND PARKING.**

OEM's heaviest duty, power assisted brakes, linings, and parking brake shall be furnished on the OEM chassis offered. Antilock brake systems shall be furnished when available from the OEM.

##### **3.6.5.5 SPECIAL TRACTION (REAR END) DIFFERENTIAL.**

All ambulances shall have a positive traction, limited slip differential or automatic, locking type differential, unless not furnished with the OEM's AVSC system.

##### **3.6.5.6 SUSPENSION.**

Vehicle shall be equipped with laterally matched sets (front and rear) of spring, torsion, or air suspension system components. Components shall have a rated capacity in excess of the load imposed on each member. Only corrections permitted by the OEM to compensate for lean due to normal spring tolerance variations are permitted. Correction of lean due to imbalance is not permitted.

**3.6.5.7 SPRING STOPS.**

The OEM's standard spring bumpers and axle stops shall be furnished. The stops/bumpers shall prevent the wheel and axles from striking the engine, oil pan, fenders, and body under all conditions of operation.

**3.6.5.8 SHOCK ABSORBERS.**

Shock absorbers, double-acting type, heaviest duty available from OEM for model offered, shall be furnished on the front and rear axles.

**3.6.6 STEERING.**

The OEM's standard, power assisted steering shall be furnished.

**3.6.7 WHEELS.**

Types I, I AD, III & III AD ambulances shall be equipped with dual rear wheels and single front wheels. Type II ambulances shall be equipped with single, front and rear wheels. Wheels shall conform to the recommendations of the Tire and Rim Association, Inc., and shall be identical in type, size, and load rating for all wheels on the ambulance.

**3.6.8 TIRES.**

Tires shall be as furnished by the OEM and shall be OEM tubeless, steel belted radials.

**3.6.9 TIRE CHAINS AND CLEARANCE.**

Tire chain clearance on the furnished body shall be provided for all driving wheels per SAE J683. Sufficient chain clearance shall be provided to permit off road operation with the ambulance loaded to the maximum payload.

**3.6.10 WHEEL TIRE BALANCING.**

Wheel/tire, hubs, and brake drum assemblies of the vehicle shall be dynamically balanced to a minimum of 70 mph.

**3.6.11 HUBCAPS.**

When available from the OEM standard hubcaps or wheel covers shall be furnished on Type II ambulances.

## **3.7 ELECTRICAL SYSTEM AND COMPONENTS.**

### **3.7.1 ELECTRICAL SYSTEM.**

The ambulance electrical system shall be equipped with, but not limited to, the following:

1. Dual, OEM's batteries.
2. Generating, starting, lighting, visual and audible warning systems.
3. Specified electronics equipment and devices (including master consoles located in the cab and patient compartment).
4. Other specified accessory wiring.
5. All electrical system components and wiring shall be readily accessible through access panels.
6. All switches, indicators, and controls shall be located and installed in a manner that facilitates easy removal and servicing.
7. All exterior housings of lamps, switches, electronic devices, connectors, and fixtures shall be corrosion resistant and weatherproofed.
8. Electrical fixtures attached to the exterior sides of the ambulance below the 75" level shall be near flush mounted and not protrude more than 2", except for such items as spotlights and ventilators.
9. All electrical devices and equipment installed, including the electromagnetic coils of high current solenoids, and relays etc, which produce RFI, shall include filters, suppressers, or shielding to prevent electromagnetic radiation and the resultant interference to radios and other electronic equipment.
10. Vehicles shall be immune from interference caused by radio transmissions.

#### **3.7.1.1 WARNING INDICATORS.**

The electrical system shall incorporate a warning light panel located in the driver's compartment. It shall provide indicator lights for:

1. Open patient compartment entry doors.
2. Open cab entry doors (when available from the OEM).
3. Open equipment compartment door(s).
4. Extended devices (flood lights, etc).

The "Door/Equipment Open" indicator in the driver's compartment can be either a warning incandescent light with at least 0.2 sq. in. of lighted surface, an electronic text message visible in all ambient lighting conditions, or LED's with equal intensity as an incandescent light source.

Electronic displays that are visible in all ambient light, that projects narrative information may be used in lieu of discrete, colored, indicator/ warning lights provided the projected message is at least as visible as the basic required warning light.

#### **3.7.2 WIRING INSTALLATION.**

1. The ambulance body and accessory electrical equipment shall be served by circuit(s) separate and distinct from vehicle chassis circuits.
2. All wiring provided by the FSAM shall be copper.
3. All wiring shall have type SXL or GXL high temperature cross-linked polyethylene, or better, insulation.
4. The use of multi conductor or ribbon cables are permitted provided they are not exposed to under hood or under vehicle temperatures/conditions.
5. The wiring shall be permanently color coded or marked the entire length of the wire.

6. Wiring shall be routed in conduit or high temperature looms with a rating of 300°F.
7. When cables are supplied by a component manufacturer to interconnect system components, these cables need not be continuously color coded/identified. They shall be coded/identified at the termination or interconnection points.
8. All added wiring shall be located in accessible, enclosed, protected locations and kept at least 6" away from exhaust system components.
9. Electrical wiring and components shall not terminate in the oxygen storage compartment except for the oxygen controlled solenoid, compartment light, and switch plunger or trigger device.
10. Wiring necessarily passing through an oxygen compartment shall be protected from damage.
11. All conduits, looms, and wiring shall be secured to the body or frame with insulated metal cable straps.
12. All apertures on the vehicle shall be properly grommited for passing wiring.
13. All items used for protecting or securing the wiring shall be appropriate for the specific application and be standard automotive, aircraft, marine, or electronic hardware.
14. Cable ties shall not be used to support harnesses, but may be used for bundling purposes.
15. Electrical panels that are accessible to accidental contact shall have a protective cover, shield, etc. to prevent shorts that can result in injury, fire, or damage to the electrical system.

#### **3.7.2.1 WIRING CRITERIA.**

1. All wiring (including grounds), devices, switches, outlets, etc., except circuit breakers, shall be rated to carry at least 125% of the maximum ampere load.
2. A service loop of wire or harness shall be provided at all electrical components, terminals, and connection points.
3. All splices and terminals provided shall comply with SAE J163, J561, or J928 as applicable.
4. All terminals shall be permanently numbered or coded.
5. Terminal strip(s) block(s), or multi-pin connector(s) shall be readily accessible for checking and service.
6. All exterior wiring to lights or any other component shall utilize sealed connectors or splices.
7. The ambulance electrical system shall incorporate a master circuit breaker panel with circuit breakers or other electronic, non-disposable, current protection devices, in each circuit, which comply with SAE J553 Type I, or Type III (if circuit breaker is readily accessible for resetting by the driver or EMSP).
8. When multiconductor cables/ribbon cables are used for low current (self limiting) circuits, additional fuses/circuit breakers are not required.
9. One extra 15-ampere circuit breaker shall be provided for future use.
10. For high current circuits, where SAE Type I breakers are not commercially produced, protection for these circuits may be provided with other types of circuit breakers.
11. All circuit breakers shall be securely mounted, easily removable, and readily accessible for inspection and service.
12. All electrical and electronic components, switches, connectors, circuit breakers, lamps, and indicators, including the vehicle batteries, shall be marked with an easily read identification code number and/or letter.

### **3.7.2.2 PRINTED CIRCUITS.**

When printed circuits are utilized, they shall conform to IPC A-610D standards, "Acceptability of Electronic Assemblies." Printed circuit assemblies provided must qualify under Classification 1.4.1 as class 3 for "Life Support or other Critical Assemblies." Printed circuit board connections and components shall conform to all other specification requirements.

### **3.7.3 GROUNDING.**

Dedicated grounds for all appliances, circuits, etc. shall be furnished. The use of appliance mounting screws/hardware shall not be used for grounding purposes unless specifically designed for such use by the appliance manufacturer.

#### **3.7.3.1 RF GROUNDING.**

To provide RF grounding and minimize potential interference with OEM's computers, the module and chassis cab shall be connected to the chassis frame with a separate dedicated minimum 3/4", braided ground strap with soldered ends that are secured to cleaned metal surfaces on the body and frame with lock washers. To prevent corrosion, both ends of the attached ground strap shall then be sealed with either rust proofing compounds or non-hardening battery terminal sealer. Regular stranded copper wire, while providing a DC ground, does not provide RF grounding and does not meet this requirement.

### **3.7.4 WINDSHIELD WIPERS AND WASHERS.**

Vehicle shall be equipped with OEM intermittent windshield wipers.

### **3.7.5 HORNS.**

The OEM's dual electric horns shall be furnished.

### **3.7.6 LOW VOLTAGE ELECTRICAL SYSTEM.**

The ambulance shall, when available from the OEM, be equipped with standard or optional generating system designed for ambulance applications, and shall be nominally rated at 14 volts, with a minimum under hood temperature of 200°F. As a minimum, the generating system shall be capable of supplying at its regulated voltage, at 200°F, the continuous electrical load, which consists of the following electrical equipment and systems:

1. Engine/transmission control system.
2. Headlights (low beam).
3. All FMVSS 108 lights.
4. Windshield wipers (low speed).
5. Cab air conditioning (at coldest setting with highest blower speed).
6. Radio in receiving mode (or equal load, if not equipped).
7. Patient module dome lighting (in the high intensity setting).
8. Patient module air conditioning (at coldest setting with highest blower speed).
9. Emergency warning lighting system (in the daytime "primary" mode).
10. 20 amp medical load or equal.

The generating system shall supply the maximum electrical load, at the regulated voltage, at 200°F under hood temperature, and with an engine speed not exceeding of the furnished engine manufacturer's high idle setting in order to maintain battery charge at the regulated voltage. The throttle control device shall control the engine RPM necessary to maintain the heating and air conditioning systems, at full operating capacity, and to maintain the generating system's required output when the vehicle is stationary and the parking brake is set. The 12-volt electrical system shall incorporate a voltmeter and low voltage warning device which is functionally connected as shown in Figure 3. The FSAM shall test each ambulance prior to delivery and provide, to the purchaser, a written certification indicating the amount of generating capacity remaining, at the regulated voltage, at 200°F, after supplying the total electrical load as manufactured (including the purchaser options).

#### **3.7.6.1 ENGINE HIGH-IDLE SPEED CONTROL.**

The OEM Engine High-Idle speed control shall be furnished. The control shall be set to automatically increase the engine speed (RPM) to the engine manufacturer's recommended setting to sustain the ambulance's total continuous electrical load at the regulated voltage and provide maximum heating/air conditioning output.

The device shall operate only when switched to the "ON" position and the transmission is in "PARK" or "NEUTRAL." The parking brake shall be applied at all times when the Engine High-Idle speed control is in use.

The device shall disengage high idle operation according to OEM and/or engine manufacturer disablement strategy, or if not specified, when the operator depresses the service brake pedal or the transmission is placed in gear.

#### **3.7.6.2 VOLTMETER AND VOLTAGE MONITOR.**

A voltmeter illuminated for nighttime operation shall be furnished. The electrical system shall be monitored by a system that provides an audible and visual warning in case of the low voltage to persons in the ambulance of an impending electrical system failure caused by the excessive discharge of the batteries. The charge status of the battery shall be determined by direct measurement of the battery voltage. The alarm shall sound if the system voltage at the battery drops below 11.8V for 12V nominal systems for more than 120 seconds.

#### **3.7.7 BATTERY SYSTEM.**

Two batteries (or additional batteries as required by the OEM) for ambulance use shall be furnished. The batteries shall be equivalent to the OEM batteries. Batteries shall be located in a ventilated area, sealed off from occupant compartments, and shall be readily accessible for servicing and removal. When batteries are mounted in the engine compartment, they shall be provided with a heat shield as a safeguard against high under hood temperatures when relocating batteries; the OEM shall approve the method of relocation.



#### **3.7.7.1 AUTOMATIC CHARGER/CONDITIONER.**

An automatic charger/conditioner shall be provided.

1. The charger/conditioner shall be connected to the 12-volt DC battery system as shown in Figure 3.
2. The charger/conditioner shall be capable of supplying a minimum of 10 amperes charging current.
3. The charger/conditioner shall be permanently mounted, in the vehicle, in a properly ventilated, accessible location and wired to the 125-volt AC utility power as shown in Figure 4.
4. The battery conditioner shall monitor the battery state of charge and, as necessary, automatically charge or maintain the batteries without gassing, depleting fluid level, overheating, or overcharging.
5. A permanently mounted decal or engraved plate shall be furnished in a conspicuous location in the cab stating:

*"This vehicle is equipped with a battery conditioner to maintain batteries in a full state of charge, and a dedicated 12-volt recharging circuit for portable battery powered equipment. For operation, vehicle shall be plugged into 125-volt AC shore power during periods of non-use."*

#### **3.7.7.2 PORTABLE EQUIPMENT CHARGING CIRCUIT.**

A circuit shall be furnished (Figure 5) for charging all portable battery powered devices, i.e. suction units, hand lights, portable radios, etc. This circuit shall prevent discharge of chassis batteries by only permitting the charging of portable devices when the vehicle is either running or the optional battery conditioner is connected to shore power. Circuit breaker protection shall be provided and shall have a minimum 10 amp capacity. An additional tagged, identified lead shall be furnished in both the cab and module for connection of additional (future) portable equipment that requires recharging.

#### **3.7.7.3 INTERNAL 12-VOLT DC POWER (REFERENCE FIGURE 3).**

Two automotive "Power Point" type connectors shall be furnished, in the patient compartment. Each connector shall be rated for 12-volt DC, 20 ampere capacity, and be on a separately protected circuit. This circuit shall also include a (low voltage drop) "Schottky" diode to isolate medical equipment batteries from any electrical loads that the remainder of the ambulance electrical system may impose. The "Schottky" diode shall be heat-sink mounted, have an inverse voltage rating of at least 45 volts and also be rated to carry the maximum short circuit current, until the circuit breaker opens. The diode shall be physically located in an accessible location and be electrically connected between the circuit breaker and the "action wall" mounted connectors.

#### **3.7.7.4 MASTER MODULE DISCONNECT SWITCH OR DEVICE.**

An illuminated "Module Disconnect" switch shall control all electrical loads added by the FSAM, or an illuminated switch controlled solenoid as shown in Figure 3. This switch shall be located in the driver's compartment, be legibly marked, illuminated when "ON," and rated to carry at least 125% of the circuit's maximum current. The module disconnect switch or device shall be different in feel from other switches, or be physically isolated from them.

### **3.7.8 125-VOLT AC UTILITY POWER (REFERENCE FIGURE 4)**

The ambulance shall be furnished with a 2-wire plus ground 125-volt AC wiring system that is separate and distinct from the vehicle's DC wiring system(s). Listing shall be by a nationally recognized testing laboratory, recognized by OSHA under Appendix A to 29 CFR 1910.7. The AC system is to be utilized while the vehicle is stationary for powering maintenance devices, medical equipment and battery chargers. The AC system shall not be utilized for operational ambulance interior lighting, such as dome and cot lights.

#### **3.7.8.1 UTILITY POWER CONNECTOR.**

A 125-volt AC flanged inlet conforming to NEMA 5-15, with spring loaded cover assembly suitable for wet locations, shall be installed on the driver's side of the ambulance body in close proximity to driver's door. The connection shall be permanently labeled with the following:

*THIS CONNECTION IS FOR 125-VOLT AC, 60 Hz, 15-AMPERE SUPPLY.*

This receptacle shall energize the vehicle's internal AC circuit from an external power source (utility power). The purchaser's stationary utility power circuit supplying the ambulance's 125-volt AC power should incorporate ground fault protection. A proper mating, weatherproof, 15 ampere connector body conforming to NEMA 5-15 shall also be furnished without cable and tagged specifying the size, type of wire necessary, and the polarity of the future hookup.

#### **3.7.8.2 ELECTRICAL 125-VOLT AC RECEPTACLES.**

The patient compartment shall be furnished with two (2) 125-volt AC duplex receptacles conforming to NEMA 5-15. Receptacles shall be near flush, vertically mounted. All interior outlets shall be installed in accordance with Section 210-7 (Receptacles and Cord Conductors) of the NEC. One outlet shall be located on the primary patient action wall and the other shall be located in the right front cabinet/storage area. Both outlets shall be at least 12 in from any oxygen outlet. An indicator shall be located within each 125-volt AC receptacle as a line monitor indicating a live (hot) circuit. The receptacles shall be labeled with the following: "125-VOLT AC."

#### **3.7.8.3 125-VOLT AC SYSTEMS.**

1. The electrical equipment and material indicated for connection to a wiring system rated 125 volts, nominal, 2-wire with ground shall incorporate a minimum 15 ampere circuit breaker which can be used as a master AC disconnect switch.
2. The AC wiring shall utilize stranded wire, Type SO or Type SEO cord with a WA suffix, rated at 600V and 194°F, covered with a minimum 300°F flame retardant wire loom, or approved wire in conduit.
3. All products shall be used only in the manner for which they were tested and found suitable.
4. Other sources of AC power shall be wired in full conformity with the requirements of this standard.
5. Grounding shall be in accordance with Section 250-6 [Portable and Vehicle Mounted Generators] of the National Electrical Code (NEC).
6. All 125-volt AC receptacle outlets of the ambulance shall have ground fault circuit interrupter protection.

7. Where rigid metal conduit or intermediate metal conduit is terminated at an enclosure with a lock nut and bushing connection; two lock nuts shall be provided, one inside and one outside of the enclosure. All cut ends of conduit shall be reamed or otherwise finished to remove rough edges.
8. Boxes are required for all inlets and/or outlets.
9. Non-metallic boxes shall be acceptable only with non-metallic conduit.
10. Boxes shall be mounted in accordance with Article 370 [OUTLET, DEVICE, PULL AND JUNCTION BOXES, CONDUIT BODIES AND FITTINGS] of the NEC.
11. No bend shall have a radius of less than five times the cable or conduit diameter, whichever is greater.
12. Tubing, conduit and loom shall be supported with clamps at the outlet boxes, distribution panel boards and splice boxes on appliances. Supports shall be provided every 24".
13. Where subject to physical damage, exposed type SO cable will be protected by guard strips, raceways or other means.
14. The branch circuit over current devices shall be rated:
  - a) Not more than the circuit conductors and
  - b) Not more than 150% of the rating of a single appliance rated 13.3 amperes or more and supplied by an individual branch circuit, or according to the appliance manufacturer, but
  - c) Not more than the over current protection size marked on motor-operated appliances

#### **3.7.8.4 DISTRIBUTION BOX.**

1. The distribution box shall be of the dead-front type and shall be installed in a readily accessible location.
2. The distribution panel board shall have a grounding bus with sufficient terminals for all chassis grounding and separate neutral grounding conductors or other approved grounding means.
3. The grounded circuit conductor (neutral) shall be insulated from the equipment grounding conductors and from equipment enclosures and other grounded parts. The grounded (neutral) circuit terminals in the distribution panel board and in appliances shall be insulated from the equipment enclosure.

#### **3.7.8.5 INTERIOR EQUIPMENT GROUNDING.**

- 1) In the electrical system, all exposed metal parts, enclosures, frames, fixtures, canopies, etc., shall be effectively bonded to the grounding terminals or enclosure of the distribution panel board.
- 2) Only bare wires, green colored or green wires with yellow stripes shall be used for equipment grounding conductors.
- 3) Grounding of electrical equipment shall be provided as follows:
  - a) Connection of metal raceway, i.e., conduit or electrical metallic tubing.
  - b) A connection between the one or more equipment grounding conductor and a metal box by means of a grounding screw (which shall be used for no other purpose) or a listed grounding device.
  - c) The equipment grounding conductor shall be permitted to be secured under a screw threaded into the fixture canopy other than a mounting screw or cover screw or attached to a listed grounding means (plate) in a non-metallic outlet box for fixture mounting (grounding means shall also be permitted for fixture attachment screws).
  - d) A connection between the one or more equipment grounding conductors brought into a non-metallic outlet box shall be so arranged that a connection can be made to any fitting or device in that box which requires grounding.

- e) Where more than one equipment grounding conductor or branch circuit enters a box, all such conductors shall be in good electrical contact with each other and the arrangement shall be such that the disconnection or removal of a receptacle, fixture, or other device fed from the box will not interfere with or interrupt the grounding continuity.
- f) Cord-connected appliances shall be grounded by means of an approved cord with equipment grounding conductor and grounding attachment plug.

#### **3.7.8.6 BONDING OF NON-CURRENT-CARRYING METAL PARTS.**

- 1) All exposed non-current carrying metal parts that may become energized shall be effectively bonded to the grounding terminal or enclosure of the distribution panel board.
- 2) A bonding conductor shall be connected between the distribution panel board and an accessible terminal on the chassis. Aluminum or coppered aluminum conductors SHALL NOT be used. Any ambulance that employs a unitized metal chassis-frame construction to which the distribution panel is securely fastened with a bolt and nut shall be considered to be bonded.
- 3) Grounding terminals may be of the solderless type and listed as pressure terminal connectors recognized for the wire size used. The bonding conductor shall be copper strand and equal in ampere capacity to the main supply cables.
- 4) The ambulance body and exterior covering shall be considered bonded where:
  - a) The metal panels overlap one another and are securely attached to the metal frame parts by metal fasteners or welding and
  - b) The lower panel of the metal exterior covering is secured by metal fasteners at each cross member of the chassis, or the lower panel is bonded to the chassis by a metal strap.
  - c) Metal circulating air ducts shall be bonded.
  - d) The compressed gas pipes shall be considered bonded if they are bonded to the chassis.

#### **3.7.8.7 APPLIANCE ACCESSIBILITY AND FASTENING.**

All electrical appliances shall be accessible for inspection, service, repair, and replacement without removal of permanent construction. Appliances shall be fastened in accordance with the manufacturer's directions.

#### **3.7.9 DRIVER COMPARTMENT CONTROLS.**

In addition to the left-hand drive controls and switches, the FSAM shall provide and locate, within easy normal reach and view of the driver, the specified controls, and instruments.

#### **3.7.10 PATIENT COMPARTMENT CONTROLS.**

The patient compartment controls, switches, and instruments shall be panel mounted and located within normal reach of the seated EMSP.

#### **3.7.11 MARKING OF SWITCHES, INDICATORS, AND CONTROL DEVICES.**

All switches, indicators, and control devices supplied by the FSAM shall be clearly visible to the EMSP. They shall be perceptively and permanently identified with at least 12 point letters for the noun or function, and 8 point letters for the remainder of the legend. The identifications shall be contrasting colors etched or engraved in plastic or metal, or printed and laminated in see through plastic, and grouped according to function, and mounted in illuminated or backlit panel(s) or the console.

### **3.7.12 ELECTROMAGNETIC RADIATION AND SUPPRESSION.**

In addition to OEM chassis, all added electrically operated or electrical generating devices, including alternators, air conditioning, warning light systems, electromagnetic coils of high current solenoids and relays, and medical equipment, shall be electromagnetic radiation suppressed, filtered, or shielded to prevent interference to radios and telemetry equipment aboard the vehicle and the surrounding area and shall not exceed MIL-STD 461 limits. Type certification for these devices is acceptable.

## **3.8 LIGHTING, EXTERIOR AND INTERIOR.**

### **3.8.1 AMBULANCE EXTERIOR LIGHTING.**

The basic exterior ambulance lighting shall include daytime running lights when available from the OEM. The lower front and rear side marker lights shall flash in conjunction with the directional signals. The FSAM shall furnish light assemblies that are manufactured with weather resistant materials that are installed in a manner that will not cause electrolysis of light housings or vehicle body.

### **3.8.2 AMBULANCE EMERGENCY LIGHTING.**

An emergency lighting system shall provide the ambulance with 360° of conspicuity for safety during its missions. The system shall display highly perceptible and attention getting signals that function in a modal system, and convey the message in the "PRIMARY MODE" — "Clear the Right-of-Way" and in the "SECONDARY MODE" — "Hazard, Vehicle Stopped on Right-of-Way." The ambulance standard warning light system shall not impose a continuous average electrical load exceeding 40 amperes at 14.2 volts.

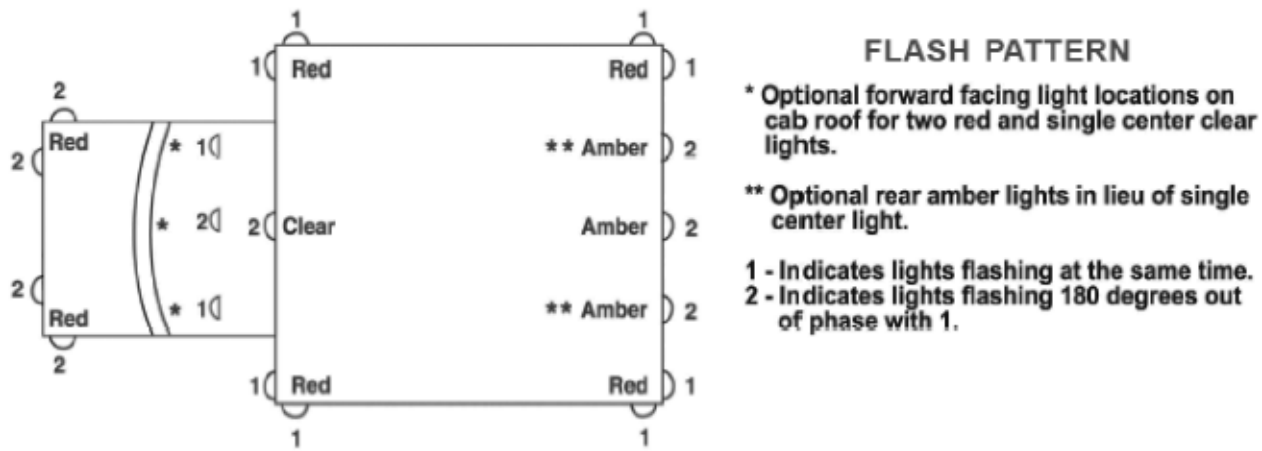
Warning light systems shall not impair the effectiveness of the ambulance's exterior lighting with conformity to the requirements of FMVSS No. 108.

#### **3.8.2.1 EMERGENCY LIGHTING SYSTEM CONFIGURATION.**

The ambulance standard emergency warning light system shall contain twelve fixed red lights, one fixed clear light and one fixed amber light. These lights shall function in a dual mode system as shown in Table 1 and meet the physical and photometric requirements. The upper body warning lights shall be mounted at the extreme upper corner areas of the ambulance body, below the horizontal roofline. The single clear light shall be centered between the two front facing, red, upper corner lights or in a dedicated housing mounted forward of the body on the cab roof. If due to limited body dimensions and physical size of the outboard forward facing lights, the lights may also be mounted in dedicated housings on the cab roof. Doors or other ancillary equipment shall not obstruct the standard warning lights. The amber light shall be symmetrically located between the two rear facing red lights. The red "grille" lights shall be located at least 30" above the ground and below the bottom edge of the windshield and be laterally separated by at least 18", measured from centerline to centerline of each lamp. The lateral facing intersection lights shall be mounted as close as possible to the front upper edge of each front fender and may be angled forward a maximum of 30°. All warning lights furnished shall be mounted to project their highest intensity beams on the horizontal plane.

Alternate approved lighting systems are NFPA 1901 compliant or SAE J2498 compliant.

TABLE 1– Emergency Lighting



MINIMUM FLASH ENERGY, Cd-S PER FLASH, PER FIXTURE				
COLOR	RED		CLEAR	AMBER
LOCATION	GRILL & FENDERS	UPPER BODY CORNERS	FRONT CENTER	REAR CENTER*
DAY	160 Cd-S @ HV	240 Cd-S @ HV	900 Cd-S @ HV	600 Cd-S @ HV
	80 Cd-S @ $\pm 5^{\circ}$ H Points	120 Cd-S @ $\pm 5^{\circ}$ H Points	450 Cd-S @ $\pm 5^{\circ}$ H Points	300 Cd-S @ $\pm 5^{\circ}$ H Points
	12 Cd-S @ All $5^{\circ}$ V - $45^{\circ}$ H Points	32 Cd-S @ All $5^{\circ}$ V - $45^{\circ}$ H Points	96 Cd-S @ All $5^{\circ}$ V - $45^{\circ}$ H Points	72 Cd-S @ All $5^{\circ}$ V - $45^{\circ}$ H Points
NIGHT	10 - 30% of the above			

\* Single center rear or combined dual rear (Optional)

MODAL EMERGENCY LIGHTING SYSTEM				
COLOR & LOCATION  MODE OF OPERATION	RED	CLEAR	AMBER	RED
	Front and Rear Corners	Front Upper Center	Rear Center	Grille and Fender
PRIMARY "Clear the Right-of-Way"	ON	ON	ON	ON
SECONDARY "Hazard-Vehicle Stopped on Right-of-Way"	ON	OFF	ON	OFF

### **3.8.2.2 PHOTOMETRIC, CHROMATICITY, AND PHYSICAL REQUIREMENTS.**

Each emergency light shall flash 75 to 125 times per minute. The chromaticity values of the lights shall conform to SAE J578, for their respective color, except for the red lights, which may conform to the following expanded boundary limits of:  $y = 0.34$ ;  $y = 0.32$ ;  $x = 0.62$ . All warning lights shall project a beam spread of at least 5° up and 5° down and at least 45° left and right of H-V. Each light shall produce flash energy, (Cd-s) per flash, measured from the H-V to all the extreme test point coordinates and shall be tested at all 5° increments. At no point shall the Cd-s values drop to less than the minimum values as shown in Table 1 when tested at 14.2 volts. Flash energy shall be determined in accordance with the SAE J845 method for determining the flash energy of a light. Testing shall be conducted on the device(s) as manufactured including use of the actual light source and all other related system components.

### **3.8.2.3 SWITCHING ARRANGEMENTS.**

The emergency light switches shall be wired and arranged to provide the warning light signal modes and combinations as specified. All emergency light switches shall be labeled and each Primary/Secondary mode switch shall have indicator light to show the driver which mode is activated.

### **3.8.2.4 HARDWARE CONSTRUCTION AND INSTALLATION.**

The emergency lighting system shall be comprised of components and devices that comply with the general requirements and tests of SAE J575, J576, J578, and J551, as applicable for the unit. Warning lights shall be firmly fastened to reinforced body surfaces in accordance with the lighting manufacturer's requirements and recommendations and include aiming wedges to compensate for sloped body surfaces, grill, hood and fender angles or mold release angles on roof caps. The FSAM shall aim the lights to assure that all lighting performance requirements herein are met. The lights shall be aimed either mechanically or optically on the horizontal axis with a tolerance of +0° to -3°.

All switches, connectors, and wiring shall be rated to carry a minimum of 125% of their maximum ampere load. When halogen or other long duty cycle light source is used, the duty cycle of any device shall not exceed 50%. When strobe lights are furnished, all high voltage leads and connections shall be insulated and enclosed, or weatherproof connectors, with the proper voltage rating shall be used.

### **3.8.2.5 TESTS, WARNING LIGHT SYSTEM.**

The lighting manufacturers shall furnish and certify or the FSAM shall measure and record the total average current load of the standard emergency warning light system on the vehicle as manufactured at the regulated voltage of 14.2 volts, when operated in the mode which draws maximum current. The warning light system and related components and devices shall be tested and approved by an Automotive Manufacturers Equipment Compliance Agency (AMECA) accredited laboratory independent from the lighting device manufacturer's own labs and listed with the AMECA for compliance with the requirements in this specification.

### **3.8.3 FLOOD AND LOADING LIGHT (EXTERIOR).**

Flood and loading lights shall be not less than 75" above the ground and unobstructed by open doors. Floodlights shall be located on the sides, and a patient loading light on the rear of the ambulance. They shall be firmly fastened to reinforced body surfaces, below the roofline. These floodlights shall be mounted on fixed body surfaces. Floodlight switches shall be located on the cab console and control each side independently. Loading light(s) shall automatically be activated when rear doors are opened.

### **3.8.4 AMBULANCE INTERIOR LIGHTING.**

The basic interior ambulance lighting configuration shall be designed to minimize electrical loads and include: A driver's compartment dome light; instrument panel lights; master switch panel; and console light(s). Lighting shall be designed and located so that no glare is reflected into the driver's eyes or his line of vision, from switch control panels or other areas that are illuminated while the vehicle is in motion. The EMSP's control panel shall be separately illuminated. All lights shall have lampshells and housings grounded.

#### **3.8.4.1 PATIENT COMPARTMENT ILLUMINATION.**

The patient compartment floor shall not be less than 15 foot candles intensity, measured along the centerline of the clear floor. The primary cot shall be provided with a minimum of 35 foot candles of illumination measured on at least 90% of the cot's surface area.

Blue light(s) or lenses shall not be used. Patient compartment lights shall not be powered by the vehicle's AC system if so equipped. The patient compartment dome lighting (in the dim setting) and exterior corresponding loading lamp(s) shall be automatically activated when the side entry or rear entry patient compartment doors are opened. All interior dome lighting, including "checkout" lights, shall be near flush mounted and not protrude more than 1.5".

Dome lighting shall not consume more than 25 amps in the bright setting and shall have two separately protected and controlled circuits. Switches, electronic controls, or fireproofed rheostats may be used to control lighting.

## **3.9 CAB-BODY DRIVER COMPARTMENT AND EQUIPMENT.**

### **3.9.1 DRIVER'S COMPARTMENT, CAB-BODY STRUCTURE.**

All cab compartments shall be of sufficient size to accommodate a driver and passenger, with space to perform driving and control activities. The cab shall be organized and designed with the specified and required equipment and accessories for ease of operation and safety. There shall be a console convenient to driver in the drivers cab. The console shall contain all added switches for operation of the ambulance.

### **3.9.2 CAB-BODY PROVISIONS.**

An OEM two door cab shall be furnished that is suitable for the subsequent mounting of various ambulance equipment and bodies.

Driver's cab section shall provide:

- a. Forward hinged doors.
- b. Opening side windows.
- c. Door stops.
- d. External key operated door locks with two sets of keys.
- e. Trim or closed panels and headliner (washable vinyl upholstery, or flooring type materials).
- f. Floor covering (OEM's heat, noise and appearance trim packages).
- g. Panel mounted instruments.
- n. All exposed interior surfaces shall be painted.
- h. Armrests, mounted on each side door.



- i. Key operated ignition/starter switch.
- j. Fuel gauge(s).
- k. Oil pressure gauge.
- l. Engine temperature gauge.
- m. Speedometer with odometer.
- n. Environmental controls (heater-defroster/air conditioner, etc.).
- o. Type II Seatbelts and shoulder harness for driver and passenger.
- p. Cab lighting and controls.
- q. Tinted windshield.
- r. Dual electric horn(s).

### **3.9.3 CAB COMPARTMENT DRIVER AND PASSENGER SEAT.**

The driver's compartment shall be OEM two individual bucket-type seats (driver and passenger). The seats shall be frame constructed with cushioned springs or foam rubber, padded and upholstered to provide riding comfort. The seats shall be covered with fire-retardant, washable, nonabsorbent material. Driver's seat shall have the OEM's full, unobstructed seat track travel range of longitudinal adjustment, and a minimum of 30% of the range of inclination, but not less than the angle furnished on the OEM's standard non-reclining high back seat.

### **3.9.4 CONTROLS AND OPERATING MECHANISM.**

All controls and operating mechanisms shall be located for left-hand drive. Lever controls, equipment, items, and devices shall be installed, located, and stowed for the convenience of the purpose intended and shall not interfere with the EMSP or patient's ingress or egress of respective compartments.

### **3.9.5 OUTSIDE REARVIEW MIRRORS.**

Dual rearview OEM mirrors having a combination flat/convex mirror system, shall be furnished. The mirrors shall be the largest available from the OEM. When available from the OEM, all four mirror head faces shall be independently adjustable. Hardware and mirror heads shall have a corrosion resistant exterior finish.

### **3.9.6 BUMPERS AND STEPS.**

OEM's standard chrome bumper shall be furnished in the front of the chassis. The rear of the ambulance shall be furnished with a sturdy, full-width, rear bumper, with step secured to the vehicle's chassis-frame. The bumper-step shall be designed to prevent the accumulation of mud, ice, or snow and made of anti-skid open grating metal. These steps shall not be located or exposed to the interior of the ambulance when the door(s) are closed. All necessary steps shall be at least the width of the door opening for which they are provided. The step's tread shall have a minimum depth of 5" and a maximum depth of 10". If the step protrudes more than 7" from the rear of the vehicle, a fold up step shall be furnished. The rear bumper and step shall be adequate to support a test weight of 500 lbs. without flexing. The height of the rear step shall not exceed 22".

### **3.9.7 BODY PROTECTION.**

#### **3.9.7.1 FENDERS.**

Fenders and wheel housings shall be provided to cover all tires.

#### **3.9.7.2 MUD FLAPS.**

Mud flaps, at least as wide as the tire(s), shall be provided behind the front and rear wheels and shall be reinforced at the point of attachment to the vehicle. Mud flaps may be incorporated into the running boards.

#### **3.9.7.3 FUEL FILL SPLASH PLATES.**

The painted surface of the ambulance body shall be protected from discoloration due to spilled fuel during refueling. Protection shall be provided by a drain in the fuel fill housing(s) or by splash plate(s) under the fuel fill opening.

#### **3.9.8 ENGINE HOOD.**

Engine hood and cowl shall be fitted to prevent precipitation, heat, odors, and noise from entering the interior of the cab and body. Cab compartment engine covers shall be removable for easy access to engine and components.

#### **3.9.9 CAB CONNECTING BELLOWS FOR TYPE I & I AD VEHICLE.**

A flexible, weather-tight bellows, fabricated from EPDM, Hypalon, sheet or molded rubber, or other durable materials that meet the temperature requirements herein and resist ozone, sunlight, oil, fungus, and will not crack, rot or deteriorate, shall be provided between the cab and the modular body. Bellows shall be designed for proper fit and finish and be able to absorb lateral, vertical, and torsional displacement due to body/cab movement.

### **3.10 AMBULANCE BODY AND PATIENT AREA.**

#### **3.10.1 BODY ACCOMMODATIONS.**

The ambulance body and patient compartment shall be sufficient in size to transport occupants and all specified stretchers, cots, and litters. There shall be space around the patient(s) to permit an EMSP to administer life support treatment to the primary patient during transit.

#### **3.10.2 CAB/PATIENT COMPARTMENT ACCESS WINDOW.**

The ambulance and body bulkheads shall have an aligned window opening of at least 150 sq. in., for visual checking and voice communications between the cab and the patient's compartment for non-walk through vehicles. The window in the cab or body shall be of the sliding type, shall be aligned, and connect with the modular body window opening and shall conform to requirements of the partition. The window shall be latchable from the cab side and shall be an adjustable, transparent, shatterproof panel.

#### **3.10.3 EMERGENCY MEDICAL SERVICES PROVIDER (EMSP) SEATING.**

The EMSP shall be provided with a seat conforming to all applicable FMVSS Standards, and be equipped with a safety belt and a padded back and a padded headrest. The seat shall be not less than 15" deep by 18" wide and a minimum distance of 43" from the top of the padded seat to any overhead obstruction. The EMSP seat shall be located to allow for the care of the primary patient.

#### **3.10.4 PATIENT COMPARTMENT INTERIOR DIMENSIONAL PARAMETERS.**

The patient compartment shall provide a minimum of 325 cubic feet of space (275 cubic feet of space for a Type II), less volume for cabinets, while complying with the following:

- a. The length measured from the partition to the inside edge of the rear loading doors at the floor, shall be at least 122". The compartment configuration shall provide at least 25" of unobstructed space at the head of the primary patient, measured from the face of the backrest of the EMSP seat to the nearest edge of the cot. A minimum of 10" shall be provided, from the rear edge of the cot mattress to the rear loading doors, to permit clearance for traction or long board splints.
- b. The compartment shall provide a minimum of 12" of clear aisle walkway between the edge of the primary patient cot and base of the nearest vertical feature measured along the floor.
- c. The patient compartment shall provide at least 60" height, over the primary patient area, measured from floor to ceiling panels.

#### **3.10.5 BODY, GENERAL CONSTRUCTION.**

For modular construction, the body shall be all welded aluminum or, other lightweight, inherently corrosion resistant materials of equal, or greater, strength. The exterior of the body shall be finished smooth with symmetrically radius corners and edges, and shall include doors and windows specified herein. Ambulance body, as a unit, shall be designed and built to provide impact and patient compartment penetration resistance and shall be of sufficient strength to support the entire weight of the fully loaded vehicle on its top or side, if overturned, without separation of joints or permanently deforming roof bow or reinforcements, body posts, doors, stringers, floor, inner linings, outer panels, rub-rails, and other reinforcements. Wood, or wood products, shall not be used for structural framing. As evidence that the ambulance body meets the above criteria, the FSAM's body (fabricated, modified, or converted), excluding the conventional cab, shall furnish for each body model (Type) a certification that the ambulance body meets AMD Standards No. 001, 020 & 007. Additionally, the roof structure, liner, and outer skin or cap shall be designed and constructed to prevent separation.

Any absorbent material such as carpeting, fabric, or inside/outside plastic type carpeting, etc. That resists cleaning and decontamination shall not be used.

#### **3.10.6 AMBULANCE BODY STRUCTURE.**

All parts of the ambulance body and attachments shall be fastened in a manner that will preclude loosening. All fasteners shall be of the corrosion resistant type. Cabinets, benches, partitions, oxygen cylinder holders, guide rails, and cot holders shall be attached to metal tapping plates and/or framing welded to the body structure. These components shall be fastened by welding, bolting, or self-tapping (threading) machine screws, on a minimum of 18" centers. Sheet metal, self-tapping wood/metal screws, nails, staples, etc. shall not be used in assembling the ambulance structure, except for self-threading sheet metal screws used for light trim panels and for retention of wood or composite sub-flooring. Ambulance bodies with an extended roof shall have the roof structural members permanently fastened to structural members of the body. Drip rail(s) shall be provided around the entire modular body and have drain points at each corner. Drip rails shall also be furnished over each entry and compartment door. The body, roof, and panel joints shall be watertight. All openings between the chassis-body and occupant carrying compartments shall be sealed to prevent intrusion of water, dust, and exhaust gases.

### **3.10.7 BODY MOUNTING.**

On modular ambulance bodies, to reduce stress on body and frame, minimize height above the frame, and isolate the patient compartment from noise and vibration, full floating, automotive style, rubber body mounts shall be furnished. A minimum four body mounts per frame rail not to exceed the mechanical properties of the body mounts and fasteners shall be furnished. Fasteners shall be a minimum of Grade 8.

### **3.10.8 DOORS.**

Two patient compartment door openings shall be provided.

- 1) There shall be a door opening on the right forward side and at the rear of the body for loading a patient on a cot.
  - a) The side opening shall have a single forward hinged door for modular bodies.
  - b) Double hinged doors for Type II, shall be furnished.
  - c) Door(s) shall provide a minimum right side clear opening of 30" wide and of 63" high for modular bodies.
  - d) The OEM's standard opening for Type II vehicles.
- 2) There shall be a door opening at the rear of the body for loading a patient on a cot.
  - a) Rear loading door(s) shall cover a clear opening of not less than 46" in height for modular bodies.
  - b) Minimum width of 44" for modular bodies.
  - c) The OEM's standard rear door width opening for Type II vehicles.
- 3) All ambulance body doors shall be equipped with not less than 250 sq. in. of safety glass area per door.
- 4) Each door shall have effective compression or overlapping seals to prevent leakage of exhaust fumes, dust, water, and air.
- 5) Patient compartment doors, on modular bodies, shall be flush or near flush style.
  - a) Shall be full box type construction.
  - b) Have removable inner panel.
  - c) Inner panel shall be finished with a durable, washable type material.
  - d) Shall include trim moldings around all unfinished, exposed edges.
- 6) A reflective device shall be furnished in any color meeting the reflector or conspicuity systems requirements of FMVSS 108.
  - a) Have at least 60 sq. in. of total reflective area.
  - b) Shall be installed on the interior of all patient compartment entry doors.
  - c) The reflective device shall be so positioned as to provide maximum visibility when the doors are in the fully open position.

#### **3.10.8.1 PROTECTION OF PATIENTS AND CREW.**

Upholstered padding/cushions shall be provided at the upper interior areas of the doorframes.

### **3.10.9 DOOR LATCHES, HINGES, AND HARDWARE.**

- 1) Door latches, hinges, and hardware furnished by OEM and FSAMs shall comply with FMVSS 206.
- 2) When doors are open, the hinges, latches, and door-checks shall not protrude into the access area.
- 3) All doors shall have hardware or devices to prevent inadvertent closing.
- 4) To facilitate entry and exit from the vehicle, a minimum 6", tubular or semi-oval, minimum 3/4" wide (diameter), grab handle shall be provided on the inside of each door or the adjacent body structure (in addition to a door operating handle).
- 5) Door shall be equipped with hold opens or stops.
- 6) One external operated lock, with key per door opening, shall be provided.
- 7) All patient compartment door locks shall be identically keyed.
- 8) Hardware shall be weather resistant.

### **3.10.10 FLOOR.**

- 1) The floor shall be flat, except when the area near the rear entrance door is sloped for a lower entering height.
- 2) With the exception of cot related hardware, shall be unencumbered in the door(s) access and work area.
- 3) Shall support a "Distributed Loads" Medium footprint of 400 lbs.
- 4) Metal floors shall be reinforced to eliminate "oil canning."
- 5) Floors shall be insulated against outside heat and cold.
- 6) The sub floor of the modular body patient compartment shall be water resistant.
- 7) When plywood is utilized, it shall be water resistant.
  - a) Not less than 1/2" thick, 5 ply minimum.
  - b) Shall be supported by body framework.
- 8) Under the sub floor of the modular body shall be an aluminum heat shield/splash pan, minimum 0.050", sealed with silicone or other non-hardening sealant evenly distributed around its perimeter.
- 9) The sub floor of the Type II patient compartment shall be not less than 1/2" thick density, marine or exterior grade plywood.
- 10) Fiberglass, aluminum, or other non-hydroscopic composites, with at least the equivalent strength of plywood may be used as the sub floor.
- 11) Particleboard or equivalent type materials are not acceptable.
- 12) Voids or pockets, where water or moisture can become trapped to cause rotting and unsanitary conditions, are not acceptable.
- 13) Voids and pockets shall be filled with sealer or caulking compound.
- 14) Flooring shall extend the full length and width of the patient compartment or body (including space under the cabinets, unless otherwise insulated) or prevented by exterior compartment bodies or wheel wells that extend above floor level.

**3.10.11 FLOOR COVERINGS AND COLOR.**

Floor covering shall be easily cleaned, sanitized, and harmonize with the interior color and décor of the patient compartment. The floor covering shall be seamless, one piece, no wax type, solid linoleum, vinyl, or poured epoxy or acrylic not less than 1/16" thick and permanently applied to the sub floor. The floor material shall cover the entire length and width of the compartment's working area. The covering of joints (corners, etc.), where the sidewalls and covering meet, shall be sealed and bordered with corrosion resistant cove molding or the covering shall extend at least 3" up the sidewalls.

**3.10.12 STEP WELL (SIDE DOOR).**

Steps shall be provided in the door openings. Step well shall be the enclosed two-step type. Height of the bottom step shall not exceed 22". Step wells shall be lighted, and all step surfaces shall be constructed with anti-slip material.

**3.10.13 WHEEL HOUSINGS.**

Wheel housings of modular bodies shall include metal or plastic splash shields between the body wheel housing and the wheels extending over the top of the tires to the bottom of the body side skirt-ing. Wheel house openings shall allow for tire chain usage and easy tire removal and service. OEM's standard wheel housings will be acceptable.

**3.10.14 BULKHEAD/ PARTITION FOR TYPE II, III, AND III AD VEHICLES.**

A full height and width partition or bulkhead (with or without compartments), with a walkthrough opening with a door shall be placed between the driver and patient's compartment. This partition shall be located directly behind the driver and companion seats when in the rearmost position. The partition shall be secured on the sides, ceiling, and floor by welding or bolting to tapping plates.

**3.10.14.1 DOOR / WALKTHROUGH FOR TYPE II, III, AND III AD VEHICLES.**

The door opening shall be at least 17" wide and 46" high and shall provide an aisle between the compartments. The door shall have at least a 150 sq. in., transparent, shatterproof viewing panel in the center section at the driver's eye level. The door shall be secured with a driver's side self-latching device in the open and closed positions.

**3.10.15 INSULATION.**

The entire body, sides, ends, and roof of the patient's compartment shall be completely insulated to enhance the performance of the environmental systems and prevent external noise from entering the vehicle interior. The insulation shall be a non-settling type, vermin-proof, mildew-proof, fire retardant, non-toxic, and non-hygroscopic. If fiberglass insulation is used, it shall not be exposed to water, e.g. door panels.

### **3.10.16 INTERIOR SURFACES.**

The interior of the body shall be free of all sharp projections. All hangers or supports for equipment and devices shall be mounted as flush as possible with the surrounding surface. Interior body lining and cabinetry materials, excluding the cab compartment, shall be selected to minimize dead weight.

The finish of the entire patient compartment, including interiors of storage cabinets, shall be:

1. impervious to soap, water and disinfectants.
2. mildew resistant.
3. fire resistant.
4. easily cleaned/disinfected (carpeting, cloth, and fabrics are not acceptable).

### **3.11 STORAGE COMPARTMENTS.**

Storage compartments shall be furnished for all items required by this specification and/or specified by the purchaser and include storage for, but not be limited to; backboards, portable cots/litters, stair chairs, and any other specified patient handling devices. Any absorbent material such as carpeting, fabric, or inside/outside plastic type carpeting, etc. that resists cleaning and decontamination shall not be used in any storage or patient compartment.

#### **3.11.1 INTERIOR STOWAGE ACCOMMODATIONS.**

The interior of the patient compartment shall provide a minimum volume of 35 cubic feet of enclosed stowage cabinetry, compartment space, and shelf space which shall be conveniently located for medical supplies, devices, and installed systems as applicable for the service intended. The 35 cubic feet of enclosed stowage cabinetry requirement does not apply to type II ambulances. Enclosed compartments and spaces shall be located at, in, or on the partition, sidewalls, overhead, seating areas, and doors. Compartment(s) under the floor, with opening panel(s) inside the patient compartment, shall not be acceptable. When furnished, top opening squad bench lids shall be fitted with an automatic hold open device and a quick release slam type latching device when closed.

##### **3.11.1.1 LOCATION OF MEDICAL EQUIPMENT AND SUPPLIES.**

Supplies, devices, tools, etc., shall be stored in enclosed compartments and drawers designed to accommodate the respective items. All medical devices and equipment shall be stowed or properly fastened in/on the action area according to the medical device manufacturer's directions.

##### **3.11.1.2 WASTE AND SHARPS DISPOSAL.**

The following shall be furnished: A trash receptacle compartment, with closure over opening, for general waste shall be furnished with a plastic/rubber trash can and disposable plastic liners, with 12 spare liners. The trash compartment shall be accessible to the EMSP seat. A sharps receptacle compartment/storage or a commercially available container mounted in a convenient area shall be furnished for retention of a sharps container that meets OSHA requirements.

##### **3.11.2 EXTERIOR STORAGE ACCOMMODATIONS.**

Ambulance exterior storage compartments shall be weather resistant. Exterior compartment doors and hardware shall be flush or near flush style construction. All doors shall have spring or gas tube type, hold open devices that permit one hand closure. Hardware (hinges, locks, latches, etc.) shall be rust resistant. All exterior compartments shall have latches with locks and shall be keyed alike. All exterior compartments shall be automatically lighted when opened.

### **3.11.3 STORAGE COMPARTMENTS AND CABINETS DESIGN.**

Storage cabinets, drawers, and kits shall be easily opened but shall not come open in transit. For rapid identification of contents, medical supply cabinets above the litter patient shall have shatter-proof, transparent or lightly tinted, sliding doors.

- 1) Doors shall be provided with near flush grip, or low profile handles.
- 2) Storage compartments shall be divided into sections.
  - a) Drawers shall be marine style slide or tilt.
  - b) All shelves shall be removable.
- 3) Sliding doors for cabinets designed to carry lightweight items such as dressings, bandages, etc. shall be furnished.
  - a) Shall automatically latch or be fitted with friction holding devices when in a closed position.
- 4) Doors shall have positively locked latches that are bolted to the door and the door frame structure and are designed to remain closed during transports.
- 5) All cabinets shall be firmly anchored (bolted or welded) to tapping plates of the body structure.
  - a) Use of sheet metal or wood screws is not acceptable.
- 6) Tops of the cabinets and shelves shall be surrounded by a lip of not less than 1/2" in height covered in a soft, pliable molding.
- 7) Storage for the main oxygen cylinder shall be accessible for replacement from an outside position.
- 8) The oxygen compartment shall be provided with at least a 9 sq. in. of open vent to dissipate/vent leaking oxygen to the outside of the ambulance.
- 9) Oxygen cylinder compartment shall not be utilized for storage of any other equipment.
- 10) Oxygen cylinder(s) shall be mounted with a restraining device(s).

### **3.11.4 PATIENT COMPARTMENT SEATING.**

All seats in the patient compartment shall conform to applicable FMVSS Standards, will be padded and have the largest practical padded back and headrests. Padding material shall be rubber or polyester urethane foam of a medium to firm density, with a minimum finished thickness (padding and upholstery) of 2.5" for seat pads, and 2" for head and backrests. All padding and upholstery shall be fire retardant. The upholstery shall be non-absorbent, washable and impervious to disinfectants. Non-OEM seats shall have 40 oz. (minimum) reinforced vinyl upholstery. To facilitate cleaning and disinfecting, all seats furnished and installed by the FSAM shall be cleanable to OSHA standards, and all exposed surfaces shall be free of vent devices that would permit the entrapment of biological contaminants.

All seating positions in the patient compartment shall be provided with a vertical overhead clearance measurement of 43".

#### **3.11.4.1 PATIENT SEATING.**

The seats shall provide seating space for two persons and shall not be less than 15" deep by 18" wide (per seating position), and the seat backs shall be a minimum of 18" wide by 7" tall. The requirement to provide patient seating space for two persons shall not apply to Type II ambulances.

### **3.11.5 SEAT SAFETY BELTS AND ANCHORAGES.**

All designated seating positions in the patient compartment shall be equipped with safety restraint systems appropriate for each type of seating configuration.



### **3.11.6 LITTER FASTENERS AND ANCHORAGES.**

A cot fastener assembly with quick release latch shall be furnished. The installed cot fastener device(s) for wheeled cots shall be installed per the manufacturer's directions. At a minimum, the litter retention system, anchorages, and litter fastener(s) shall not fail or release when subjected to a force of 2,200 pounds applied in the longitudinal, lateral, and vertical direction. Should the manufacturer of the cot fastener assembly specify a greater force, the litter retention system, anchorages, and litter fastener(s) shall be tested to that greater force.

***ALL COTS AND INFANT TRANSPORTERS SHOULD ONLY BE USED WITH THE REQUIRED FASTENER ASSEMBLY AS PRESCRIBED BY THE COT/TRANSPORTER MANUFACTURER.***

### **3.11.7 IV HOLDER FOR INTRAVENOUS FLUID CONTAINERS.**

One ceiling mounted "hook" style device specifically designed for holding IV containers shall be provided, including Velcro type straps to adequately secure an IV bag/bottle. The device shall not protrude more than 1", and shall be located adjacent to, or on the cabinetry near the head of the primary patient. Swing down IV hangers with rigid support arms that can cause injury shall not be specified or furnished.

## **3.12 OXYGEN, MAIN SUPPLY AND INSTALLATION.**

The ambulance shall have a piped medical oxygen system capable of storing and supplying a minimum of 3,000 liters of medical oxygen. The installed medical oxygen piping and outlet system shall be leak tested to 200 PSI. After the successful completion of tests, the system shall be capped then tagged with date and signature of person and firm performing the tests.

The main oxygen supply shall be from a single compressed gas cylinder that the consignee will provide and install at the time the vehicle is placed in service. A cylinder changing wrench shall be furnished. The wrench shall be chained and clipped within the oxygen cylinder compartment.

The cylinder controls shall be accessible from the inside the vehicle. A device shall be visible from the EMSP's seat that indicates cylinder pressure. The use of remote high pressure lines and gauges are not allowed. The oxygen cylinder shall be accessible for changing from the exterior of the body.

The purchaser shall specify the type of quick disconnect, to be used. The FSAM shall install all other components and accessories required for the piped oxygen system which shall include as a minimum:

- A pressure regulator.
- Low pressure, electrically conductive, hose approved for medical oxygen.
- Oxygen piping concealed and not exposed to the elements, securely supported to prevent damage, and be readily accessible for inspection and replacement.
- Oxygen piped to a self-sealing duplex oxygen outlet station for the primary patient with a minimum flow rate of 100 LPM at the outlet.
- Outlets shall be adequately marked and identified and not interfere with the suction outlet.

### **3.12.1 OXYGEN PRESSURE REGULATOR.**

The medical, oxygen pressure reducing, and regulating valve with inlet filter at the cylinder shall have line relief valve set at 200 psi maximum, and a gauge or digital monitor with a minimum range of 0 to 2,500 psi with the gauge or display scale graduated in not more than 100 PSI increments. The regulator shall be easy to connect and preset, with a locking adjustment, at 50 +/- 5 psi line pressure, permitting a minimum 100 LPM flow rate at a bottle pressure of 150 psi.

### **3.12.2 SUCTION ASPIRATOR, PRIMARY PATIENT.**

An electrically powered suction aspirator system shall be furnished with an illuminated switch and a panel mounted, labeled, quick disconnect inlet device on the EMSP panel. The electric type aspirator system shall be connected per Figure 3. The suction pump shall be located in an area that is accessible but sound and vibration insulated from the patient compartment.

- 1) The pump shall be vented to the vehicle's exterior.
- 2) A vacuum control and a shut-off valve, or combination thereof, shall be provided to adjust vacuum levels.
- 3) A vacuum indicator gauge of 3" +/-0.5" in diameter, with numerical markers at least every 100 mm Hg and a total range of 0 to 760 mm Hg, shall be provided.
- 4) The collection bottle or bag shall be non-breakable and transparent with a minimum 1,000 ml capacity.
- 5) The minimum inside diameter for the suction tubing connectors shall be at least 1/4". The end user shall provide any suctioning catheters desired.
- (6) The suction aspirator system shall provide a minimum of 30 LPM flow at the catheter tip.

## **3.13 ENVIRONMENTAL: CLIMATIC AND NOISE PARAMETERS.**

### **3.13.1 ENVIRONMENTAL SYSTEMS.**

All ambulances will be equipped with a complete heating, ventilating, and air conditioning system(s) (HVAC) to supply and maintain clean air conditions and specified level of inside temperature in both driver and patient compartments. The system(s) may be separate or a combination system, which will permit independent control of the environment within the driver's cab and patient compartment. All ambulances will be equipped with HVAC that can be made to collectively operate using re-circulated air and outside ambient air and will be capable of maintaining a patient compartment temperature of 68°F to 78°F while patients are in the patient compartment. The air systems will be high volume capacity with low velocity delivery for minimum draft circulation. Environmental system components will be readily accessible for servicing at the installed location(s). Connecting hoses for heating and the air conditioning system will be supported by rubber-insulated metal clamping devices at least every 18".

### **3.13.2 HEATING CRITERIA.**

The heating system(s) will have sufficient capacity to maintain the temperature in the patient compartment at a minimum dry bulb temperature of 68°F. Heater(s) will, to the maximum extent possible, be connected to the OEM's furnished interconnection points.

### **3.13.3 AIR CONDITIONING CRITERIA.**

The air conditioning system(s) will have sufficient capacity to maintain the temperature in the patient compartment at a maximum dry bulb temperature of 78°F. When available, OEMs' interconnection points will be utilized.

### **3.13.4 VENTILATION CRITERIA.**

Ventilation system(s) of the driver and patient compartments will provide a complete change of ambient air within both compartments at least every two minutes with the vehicle stationary. Ventilation will be separately controlled within the cab and patient compartments. Fresh air intakes will be located towards the front of the vehicle and exhaust vents will be located on the upper rear of the vehicle. Exhaust vents may be located on the rear lower half of the module/body, provided the vent/device incorporates a reverse flow damper to prevent back draft and intrusion of vehicle engine exhaust, dust, dirt, or road spray. The patient compartment will be ventilated by the air delivery system of the environmental equipment (heater-air conditioner) or by separate system(s), such as power intake, exhaust ventilator(s).

### **3.13.5 ENVIRONMENTAL CONTROLS.**

Adjustable, manual or thermostatically operative controls will permit heating and/or air conditioning and ventilation in either compartment without affecting the other compartment. Switches and controls will be located in "action area" panel and/or remote panel and identified for function and operating position. Blower or fan system will have at least three speeds (excluding "OFF"). Separate non-corroding brass, bronze, stainless steel, plastic or other inherently corrosion proof shutoff valves, for the patient compartment hot water heating system, will be provided. The use of vacuum or electrically operated shutoff valves is acceptable provided it will meet the above criteria and the valve provides inherent sealing when vacuum is removed. This sealing will prevent engine cooling system pressure and water pump pressure from causing any leakage when vacuum is removed. Air systems will have adjustable louvers to direct the flow of air.

### **3.13.6 PATIENT COMPARTMENT SOUND LEVEL CRITERIA.**

The patient compartment sound level shall not exceed 80 dBA at any time.

## **3.14 COMMUNICATIONS.**

### **3.14.1 COMMUNICATION EQUIPMENT.**

Any two way radio equipment shall be installed by a licensed installer approved by the radio manufacturer. Communications equipment will meet the applicable FCC rules and required state and local area EMS radio communication protocols.

### **3.14.2 RADIO (MOBILE) PROVISIONS.**

All ambulances will be provided with sufficient ventilated space for a two-way radio (including convenience features), antenna openings, ground plane, terminal wiring for 12V power and ground.

### **3.14.3 ANTENNA CABLE, AND ACCESS.**

The FSAM shall provide each ambulance with a ground plane, and coaxial lead-in wire from the ventilated radio storage area/compartments to the centerline of the patient compartment roof. An antenna wiring access/port shall be provided in the patient's compartment directly under the coaxial leads. The port shall provide at least a 16 sq. in. clear access. All nonmetallic roofs will be equipped with at least a 40" x 40" metal ground plane molded into the roof. The ground plane then shall be properly grounded to the chassis ground. The antenna cable (lead-in) shall be provided and clearly labeled with RG/58U or equal cable. Approximately 18" of extra cable shall be provided at the roof and approximately 36" at/in the radio area/compartments.

### **3.14.4 SIREN – PUBLIC ADDRESS SYSTEM.**

A combination electronic siren with integral public address system including radio interface capability shall be provided. A "Horn/Siren" switch shall be provided on the driver's console. When on shall activate or change the siren tone when the horn button is pushed. The "Horn/Siren" switch shall be illuminated (in siren mode). Dual speakers shall be installed, outside the vehicle, in the bumper/hood area. Speakers shall not protrude beyond the face of the bumper or bumper guards. The siren shall be capable of producing a continuous warning sound at a minimum level of 123 dB, A-weighted, at 10'.

## **3.15 ADDITIONAL SYSTEMS, EQUIPMENT, ACCESSORIES, AND SUPPLIES.**

### **3.15.1 ADDITIONAL AND OPTIONAL EQUIPMENT.**

This specification provides the minimum technical requirements that new ambulances are required to meet. Some purchasers will require features in excess of these minimum requirements to complete their mission(s). Completing the worksheet in this section will assist purchasers in determining the optimum type, configuration and optional equipment required.

Purchasers may wish to consider some of the following criteria before completing the worksheet:

1. Operating environments such as inner city, rural areas, length of responses
2. Exposure to extreme ambient temperatures
3. Size of ambulance crew
4. State and/or local jurisdiction required medical equipment
5. State licensure requirements
6. Vehicle size and weight limitations in the response area
7. Expected service life of the ambulance
8. Additional non EMS equipment that must be carried on the ambulance
9. Future equipment requirements
10. Additional state or local requirements
11. Export requirements

In no event shall the specified or furnished optional item(s) reduce the quality and intent of the ambulance but shall enhance its design and purpose.

### **3.15.2 STANDARD MANDATORY MISCELLANEOUS EQUIPMENT.**

Each ambulance shall be equipped with, but not limited to the following:

1. Fire extinguishers: Two, (ABC dry chemical or carbon dioxide) minimum 5 lb. unit, in a quick-release bracket, one mounted in the driver/cab compartment or in the body reachable from outside the vehicle and one in the patient compartment.
2. "No Smoking Oxygen Equipped" and "Fasten Seat Belts" signs: Conspicuously placed in the cab and patient compartment.
3. Overhead grab rail, minimum 60" long, maximum 4" depth, on the ceiling over the primary patient. Grab rail shall be stainless steel, aluminum, or other corrosion resistant material, and have padded or curved up ends, and rounded corners. Mounting brackets shall be chromed, stainless steel, polished cast aluminum or other corrosion resistant materials. The grab rail shall be tested to 300 lbs.
4. Backup alert alarm, (audible warning device) activated when the vehicle is shifted into reverse. Device shall be rated (SAE) for 97 dB-a at 4'.

### 3.15.3 CONFIGURATION WORKSHEET.

#### Reference Section 3.0 – REQUIREMENTS

This ambulance is to be a:

- ☐ BLS
- ☐ ALS
- ☐ Walkthrough
- ☐ Infrequent Transport

It is essential that the ambulance not be operated in an overloaded or unbalanced condition. The following information must be made available to properly design the interior and exterior compartmentalization of the ambulance per Section 3.5. Attach:

- a. A list of medical and rescue equipment to be supplied by the FSAM with the ambulance stating the item, quantity, where it is to be mounted or carried, the weight of each item, and its dimensions (L x W x H).
  - b. A list of medical and rescue equipment to be supplied by the purchaser to be carried on the ambulance stating the item, quantity, where it is to be mounted or carried, FSAM's responsibility for mounting, the weight of each item, and its dimensions (L x W x H).
  - c. A list of medical and rescue equipment that might be carried on the ambulance in the future stating the item, quantity, the desired mounting location or compartment where it is likely to be carried, the weight of each item, and its dimensions (L x W x H).
  - d. A list of permanently mounted equipment required on the ambulance showing the item, quantity, weight of each, and dimensions (L x W x H), who is to furnish the equipment as well as the location where it is to be carried.
1. Specify the maximum number of seated positions on the ambulance if more than five for modular bodies, or more than three for Type II units (Standard seating is two in the cab, two on the side and one in the EMSP seat for modular bodies and two in the cab and one in the EMSP seat for Type II units):
  2. Describe the usage duty cycle that the ambulance will be subjected to: \_\_\_\_\_
  3. If design approval drawings and/or a copy of the FSAM's work order are required to validate the design criteria in 3.1, the type and quantity must be detailed here. \_\_\_\_\_
  4. Careful consideration must be given to the ambient conditions the ambulance will operate in. Auxiliary heating and/or air conditioning may be required. If different than 3.4.2 and/or 3.13.1, state the minimum and/or maximum operating temperatures in °F. \_\_\_\_\_
  5. If different than 3.4.4, state the required ride performance requirements: \_\_\_\_\_
  6. If different than 3.4.5, state the required min/max road speed required: \_\_\_\_\_
  7. If different than 3.4.7, state the required gradeability: \_\_\_\_\_

8. If different than 3.4.8, state the required fuel range:\_\_\_\_\_
9. Per 3.4.10.1, state the maximum overall length in inches:\_\_\_\_\_
10. If different than 3.4.10.2, state the maximum overall width in inches:\_\_\_\_\_
11. Per 3.4.10.3, state the maximum overall height in inches:\_\_\_\_\_
12. If different than 3.4.10.4, state the required angles:\_\_\_\_\_
13. Per 3.5.2, the average weight of an occupant is calculated at 150 lbs. per NHTSA. If your average occupant weight is greater, specify here:\_\_\_\_\_  
\_\_\_\_\_
14. If a specific OEM's chassis is required in Section 3.6, list the OEM here:  
\_\_\_\_\_  
\_\_\_\_\_
15. If all-wheel drive (AWD) or all-wheel drive conversion (AWDC) is required specify here. (It should be noted that AWD and AWDC will reduce the available payload and will increase the floor loading height. In some cases the floor loading height may be increased beyond the 34" maximum).  
\_\_\_\_\_  
\_\_\_\_\_
16. A diesel engine is furnished as standard per 3.6.3. If other than a diesel engine is to be used, specify here. If a specific engine type is required, specify here: \_\_\_\_\_  
\_\_\_\_\_
17. The OEM standard exhaust location and piping configuration is required per 3.6.4.6. If an alternate location of type of piping termination is required, specify here: \_\_\_\_\_  
\_\_\_\_\_
18. An automatic transmission is furnished as standard per 3.6.5.2. If a specific transmission type is required, specify here: \_\_\_\_\_  
\_\_\_\_\_
19. The OEM standard braking system is required per 3.6.5.4. If an optional type braking system is required (air brakes, retarder, exhaust brake, etc.), specify here: \_\_\_\_\_  
\_\_\_\_\_
20. The OEM standard tires are furnished per Section 3.6.8. If an optional type tire is required, specify here. If a spare tire is required, specify mounting location here: \_\_\_\_\_  
\_\_\_\_\_
21. If automatic or manual tire chains are to be furnished to operate in the space required by 3.6.9, specify here: \_\_\_\_\_  
\_\_\_\_\_

22. If different than 3.7.5, specify the type of horn (air horn, etc.) required: \_\_\_\_\_  
\_\_\_\_\_

23. Specify any electrical loads beyond those defined in 3.7.6 that are to be part of the minimum continuous electrical load. If a load management system is required, specify the sequence of control (shutdown). If functional enhancements (OEM or non OEM) are required to the high-idle system (interlock capabilities, automatic re-engagement, etc) specify here: \_\_\_\_\_  
\_\_\_\_\_

24. The OEM standard batteries are furnished per Section 3.7.7. If an optional type battery is required, specify here. If a specific mounting location is required, specify here: \_\_\_\_\_  
\_\_\_\_\_

25. Specify any portable equipment charging provisions required in excess of those required by 3.7.7.2: \_\_\_\_\_  
\_\_\_\_\_

26. If different than 3.7.7.3, specify the number and type of power points required: \_\_\_\_\_  
\_\_\_\_\_

27. Specify any AC utility power requirements that are in excess of those required in 3.7.8: \_\_\_\_\_  
\_\_\_\_\_

28. If an on board AC power system is required to operate with the system described in 3.7.8, the following must be specified:

Wattage of power source: \_\_\_\_\_

Voltage of power source: \_\_\_\_\_

Purity of power source: \_\_\_\_\_

(allowable total harmonic distortion, voltage variation, power factor, frequency variation, etc)

Type of power source (shall be listed by a nationally recognized testing laboratory UL, CSA, etc):

☐ Portable Generator

☐ Hydraulically Driven Generator

☐ Direct Drive Generator

☐ Auxiliary Engine Driven Generator

☐ Belt Driven Generator or Alternator

☐ Derived From Ambulance Low Voltage Power Supply System (Inverter)

☐ Other: \_\_\_\_\_

Make, model, or other details of power source: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Panelboard location: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_



**AC Powered Receptacle Information**

Quantity	NEMA Conf	Location

**AC Powered Lighting Information**

Style/Make	Location	Wattage/Bulb	Type Mounting

An automatic transfer switch shall be furnished which turns off this onboard AC supply (interlock) and disconnects its output, when the AC utility power is applied. Transfer equipment, if not integral with the listed power source, shall be installed to ensure that the current carrying conductors from the on board 125-volt AC power source and from the 125-volt AC utility power source are not connected to ambulance electrical circuit at the same time. Generators shall comply with Article 445, "Generators," of NFPA 70, National Electrical Code.

The following shall be wired so that they can be energized only from the utility power, and not the onboard AC supply:

1. DC battery conditioner
2. Engine block heater

29. If different than 3.7.8.1, specify the location for the utility power connector: \_\_\_\_\_

30. If known, specify the equipment that is to be powered by the receptacles specified in 3.7.8.2: \_\_\_\_\_

31. If different than 3.7.10, specify the location(s) for the patient compartment controls: \_\_\_\_\_

32. If a specific manufacturer's DOT lighting system is required in Section 3.8.1, list the manufacturer here. State if a specific lighting system is required (such as all LED, etc.): \_\_\_\_\_

33. If a specific manufacturer's emergency lighting system is required in Section 3.8.2, list the manufacturer and type (i.e.: strobe, LED, halogen) here. State if an alternate approved lighting system is required (such as NFPA 1901 compliant or SAE J2498 compliant). State if there are specific state or local jurisdiction requirements (such as California steady burning red, etc): \_\_\_\_\_  
\_\_\_\_\_
34. Specify any work lighting required beyond those defined in 3.8.3: \_\_\_\_\_  
\_\_\_\_\_
35. Specify any interior lighting required beyond that defined in 3.8.4 (map light, high intensity cot light, etc.): \_\_\_\_\_  
\_\_\_\_\_
36. The FSAM's standard cab console will be provided per 3.9.1. If an optional type console is required (specific switch locations, specific size, etc.) specify here: \_\_\_\_\_  
\_\_\_\_\_
37. The OEM largest mirror system is required per 3.9.5. If an optional type mirror system is required (power, heated, etc) specify here: \_\_\_\_\_
38. If different than 3.10.4, state the required increase to the patient compartment interior length, width and height in inches: \_\_\_\_\_
39. A cab/patient compartment access window is required per 3.10.2. On vehicles over 14,000 lbs. GVWR the opening may be expanded to permit a walk through opening in lieu of the window. If a walk through opening is required, specify the door type and size here: \_\_\_\_\_  
\_\_\_\_\_
40. An aluminum modular body is required per 3.10.5. If an optional type body material is required specify here: \_\_\_\_\_  
\_\_\_\_\_
41. Hinged doors are required per 3.10.8. If an optional type door system is required (sliding, etc) specify here: \_\_\_\_\_  
\_\_\_\_\_
42. If a specific manufacturer's latch, locking system, grab handle system, etc. is required in Section 3.10.9, list the manufacturer and type here: \_\_\_\_\_  
\_\_\_\_\_
43. The floor is designed to carry a cot load of 400 pounds per 3.10.10. If a heavier load is to be applied to the floor (Bariatrics, etc) specify here: \_\_\_\_\_  
\_\_\_\_\_
44. If a specific manufacturer's flooring is required in Section 3.10.11, list the manufacturer and flooring type here: \_\_\_\_\_

45. Windows are required per 3.10.5. If an optional window and/or tint is required specify here: \_\_\_\_\_
46. All exterior compartments must be lighted per 3.11.2. If additional compartment lighting is required, specify here: \_\_\_\_\_
47. Removable shelving is required per 3.11.3. If optional type shelving is required (adjustable, quick loading, etc) specify here: \_\_\_\_\_
48. Patient compartment seating is required per 3.11.4. If an optional type seating is required (captain's chair, integral child safety seat, etc) specify here: \_\_\_\_\_
49. A cot fastener assembly is required per 3.11.6. Specify the type of cot to be fastened by manufacturer and model number. If a cot is to be furnished by the FSAM, specify the manufacturer and model number of the cot to be furnished: \_\_\_\_\_
50. A medical oxygen system is required per 3.12. Specify the type of outlets (DISS, NCG, Chemtron, Ohmeda, Puritan Bennett, etc) to be furnished. Specify the type and size of oxygen cylinder that will be furnished by the end user. If additional oxygen equipment is to be furnished by the FSAM, specify the manufacturer and model number to be furnished. If additional oxygen storage (more than 3000 liters) is required, specify here: \_\_\_\_\_
51. The patient compartment interior sound levels are not to exceed 80 dB per 3.13.6. If lower sound levels are required specify here: \_\_\_\_\_
52. If electronic communication between the patient compartment and the cab (silent intercom, voice intercom, headsets integrated with the radio system, etc) are required specify here: \_\_\_\_\_
53. Provisions for mobile radio equipment are defined in 3.14.2. Complete the following:  
Is the FSAM to provide the radio? ☐ Yes ☐ No  
Is the FSAM to install the radio? ☐ Yes ☐ No  
Make and model: \_\_\_\_\_  
Power requirements for radio: \_\_\_\_\_  
Mounting location for radio: \_\_\_\_\_  
Mounting location for control(s) and speaker(s): \_\_\_\_\_
54. Are there provisions required for computer equipment, drive camera, or other electronics?  
If so, list here: \_\_\_\_\_

55. If a specific manufacturer's siren and/or control system is required in Section 3.14.4, list the manufacturer here: \_\_\_\_\_
56. Specify any additional backup assist systems required beyond those defined in 3.15.2-4: \_\_\_\_\_
57. The ambulance will be painted and marked per 3.16. State if an alternate approved painting and/or marking system is required (such as NFPA compliant and/or specific state or local jurisdiction requirements). A graphic design meeting the reflectivity requirements of 3.16.4 shall be permitted to replace the required striping material if the design covers at least the same perimeter length and total area of coverage in sq. in. required by 3.16: \_\_\_\_\_
58. Each ambulance comes with an instruction manual and handbook of construction per 3.18. These documents are designed to insure that the operator of the ambulance can properly operate and perform required operator level maintenance specific to the ambulance purchased. If additional operational instruction and/or maintenance instruction is required, those requirements should be detailed here. If actual service and parts manuals are required, those requirements should be detailed here. With a few exceptions, the manual and handbook of instruction will be in electronic form. If other media is required (all paper, etc.) specify here: \_\_\_\_\_

#### **Reference Section 4.0 – QUALITY ASSURANCE PROVISIONS**

The type of inspection (source and/or destination) needs to be specified as well as where and when the acceptance inspection is to occur. \_\_\_\_\_

Section 4.0 details the minimum testing requirements for acceptance. If additional or alternative testing is required, specify here: \_\_\_\_\_

Section 4.3.3 requires 3rd party testing. If an alternate form of 3rd party validation of the testing is required, specify here: \_\_\_\_\_

#### **Reference Section 5.0 – PREPARATION FOR DELIVERY**

If a different mode of delivery or preparation for delivery than is specified in Section 5.0 the requirements should be detailed here along with the delivery address for the ambulance. \_\_\_\_\_

#### **Reference Section 6.0 – NOTES**

If an extended warranty (beyond what is required in 6.2.1) on the entire vehicle or specific components is required, indicate which component(s) and the length and scope of the warranty: \_\_\_\_\_

### **3.15.4 DEFINED OPTIONS (OPTION CODES).**

The following Option Code detailed requirements are offered for selected ambulance options.

#### **3.15.4.1 CODE "SL" SPOTLIGHT.**

A hand held spotlight shall be provided with a minimum 100,000 CP lamp, corrosion proof housing with momentary switch, and minimum 8 ft. heavy-duty coiled cord. It shall be hard wired to the vehicle 12-volt DC system (for anti-theft reasons) and stowed in a holder in a compartment/area, accessible to the driver and passenger.

#### **3.15.4.2 CODE "HPL" PADDLE HANDLE DOOR LATCHES.**

When code HPL is specified, a large automotive paddle style door handle shall be furnished for the patient entry and exterior compartment doors. The handle shall be chrome or bright metal finished and shall have a black outer trim gasket. Each handle shall be easily gripped with a gloved hand. The patient entry doors and exterior compartment doors shall be keyed alike.

#### **3.15.4.3 CODE "K40" SERVICE BEFORE OVERSEAS.**

When option K40 is specified, vehicles scheduled for overseas delivery shall be shipped to the FSAM's service center closest to the port of shipment. The service center shall ensure that the following services are performed:

1. A 3000 mile chassis service.
2. The OEM and Conversion equipment functions on the predelivery check list shall be successfully completed.
3. All open warranty items discovered as a part of this service shall be resolved.
4. The dealer shall deliver the vehicle to the port of shipment when the required services have been completed.

#### **3.15.4.4 CODE "PLV" POWER LOCKS ON BODY.**

When code PLV is specified, the side and rear patient entry doors as well as the front exterior ALS access door shall be equipped with electrically activated locks. These locks shall be interconnected to the OEM electric locks so that patient compartment and ALS access areas may be secured anytime the cab is locked. There shall further be a momentary activation switch located to the rear of the side wall adjacent to the rear patient entry doors. Switch shall be labeled Door Locks. Additionally there will be a rubber covered, weatherproof "stealth" switch that will unlock both the cab entry doors as well as the patient compartment entry doors. Switch shall be located in the front grille area.

#### **3.15.4.5 CODE "PSM & PSME" PARTS AND SERVICE MANUALS.**

When PSM or PSME is specified, the FSAM shall furnish all parts lists and service publications for the vehicle and all equipment furnished.

When PSM is specified, the publications furnished shall be printed documents.

When PSME is specified, the publications shall be electronic (CD or web-based).

NOTE: The publications may be shipped separately from the vehicle. The publications may be shipped to the consignee mailing address as shown on the Motor Vehicle Delivery Order (MVDO).

**3.15.4.6 CODE “SROV” REVERSE OBSTACLE SENSOR.**

When code SROV is specified, the vehicle shall be furnished with a sensor system that is installed on the rear of the body or rear bumper of the vehicle and detects the proximity of objects and transmits an audible signal to the driver. A switch shall be furnished that allows the driver to turn this device on/off.

**3.15.4.7 CODES “AWD & K02” OEM ALL WHEEL DRIVE.**

When Option AWD is specified, the OEM 4X4 chassis shall be furnished per specification. When Option K02A is additionally specified, the chassis shall have OEM automatic electric “shift on the fly” system.

**3.15.4.8 CODE “K11” REAR AIR RIDE SUSPENSION.**

When Option K11 is specified, OEM’s furnished or approved rear air suspension, with electrically operated dump valve, shall be furnished. The air ride suspension system shall incorporate an inter-lock system that prevents the vehicle from moving while the system is in the “dumped” configuration.

**3.15.4.9 CODE “K37” ADDITIONAL 12-VOLT POWER LEAD.**

When K37 is specified, an additional lead shall be furnished to a specified location. All leads shall be tagged.

**3.15.4.10 CODE “K32” ADDITIONAL ANTENNA & POWER LEAD.**

When Option K32 is specified, an additional antenna and an additional power lead shall be furnished to a specified location. All leads shall be tagged.

**3.15.4.11 CODE “K27” TEMPERATURE CONTROLLED DRUG COMPARTMENT.**

When K27 is specified, a temperature controlled drug compartment shall be furnished to maintain temperatures 77°F +or– 10°F. with the vehicle exposed to the ambient temperatures in 3.4.2. The electrical power for the cooling/heating shall be from the power output in Figure 3 and Figure 4.

**3.15.4.12 CODE “K49” AC/12-VOLT HEAT & AC COMB.**

When code K49 is specified, the climate control system in the patient compartment shall be capable of operating from either AC power supplied by a shoreline input or the 12-volt D.C. power supplied by the OEM chassis. The AC portion of the system shall include an auto-eject shoreline input outlet located on the street side of the vehicle and adjacent to the standard shoreline outlet. The AC input shall activate an additional air conditioning compressor and condenser as well as an AC to 12-volt converter that will power the air conditioner blower motors inside the patient compartment. The AC portion of the heating and cooling system shall be connected to the interior heat/cool thermostat located in the action area.

**3.15.4.13 CODE “K28” CAST ALUMINUM EMERGENCY LIGHT HOUSINGS.**

When code K28 is specified, all exterior emergency and flood lights shall be flush mounted in cast, polished, aluminum housings and recessed to the maximum extent possible.

**3.15.4.14 CODE “FTH” FRONT TOW HOOKS.**

When code FTH is specified, the OEM’s front recovery hooks shall be frame mounted on the front of the vehicle. The OEM’s front recovery hooks shall be provided on all 4x4 vehicles.

#### **3.15.4.15 CODE “PT” POWER TAKEOFF OPENING.**

When code PT is specified, the designated transmission or transfer case shall be provided with a usable PTO opening. When a PTO unit is provided on a vehicle, a caution plate or decal reading, “Do not operate vehicle at highway speeds with PTO engaged,” shall be installed in the cab, readily visible to the driver. Controls to operate the power takeoff shall be located in the truck cab accessible to the seated driver. The PTO unit shall have a rated capacity to operate the provided equipment.

#### **3.15.4.16 CODE “PWL” POWER WINDOWS AND LOCKS.**

When code PWL is specified, the OEM power windows and power locks option shall be provided.

#### **3.15.4.17 CODES “RA, RAD & RACD”.**

When code RA is specified, the OEM AM/FM radio with integrated clock shall be provided.

When code RAD is specified, the OEM AM/FM/clock radio with integrated compact disc player shall be provided.

When code RACD is specified, the OEM AM/FM/clock radio with integrated compact disc and cassette player shall be provided.

#### **3.15.4.18 CODE “RKE” REMOTE KEYLESS ENTRY.**

When code RKE is specified, the OEM optional remote keyless entry system shall be furnished.

#### **3.15.4.19 CODES “T5”, AND “T6”, FIVE, AND SIX SPEED MANUAL TRANSMISSION.**

When code T5, or T6 is specified, a five, or six speed manual transmission, respectively, shall be furnished. The transmission shall be furnished with a PTO opening(s) in accordance with SAE J704, unless an exception is noted under the code.

#### **3.15.4.20 CODE “AWDC” FOUR WHEEL DRIVE (4X4) CONVERSION.**

(From OEM Pass-Through Approved Dealers Only)

When code AWDC is specified, an OEM pass-through four-wheel drive conversion shall be furnished. The conversion (4x4) shall be a professionally engineered conversion from a two-wheel drive (4x2) to a four-wheel drive (4x4) meeting or exceeding all applicable requirements of the OEM. Note that available payload will likely be reduced by the weight of the conversion and all payload requirements must be reviewed accordingly prior to contract.

The transfer case selector shall have a readily visible shift diagram, if applicable, and a position indicator. A yellow, dash mounted four-wheel drive warning light shall be provided in close proximity to permanent warning decal or metal plate advising conditions under which four-wheel drive shall not be used. A dash mounted metal plate or permanent decal indicating the proper procedure for engaging and disengaging the four-wheel drive shall be provided. The front drive axle hubs shall be manually engaged. Each vehicle's rear axle shall be furnished with chassis manufacturer's special traction differential (option code D3) when available.

The 4x4 converter shall provide to the purchaser a full parts and labor warranty covering all added 4x4 parts and materials, including workmanship and design. The warranty shall also cover all OEM components affected or modified by the conversion process. This warranty shall be at least equivalent, in mileage and time, to the chassis manufacturer's original warranty, including any extended warranties required or furnished.

**3.15.4.21 CODE “RBV” RUNNING BOARD.**

When code RBV is specified, OEM running boards (Code RB) or FSAM running boards shall be furnished. The FSAM running boards shall be securely mounted to the frame of the vehicle to prevent flexing when used by vehicle occupants during entry and exit.

**3.15.4.22 CODE “LEDV” BODY EXTERIOR DOT LIGHTING, LED.**

When code LEDV is specified, the exterior DOT lighting furnished, other than the backup lamp(s), shall be LED. The lighting system shall include sealed wiring harness with return ground wiring.

The LED lights shall have a five year warranty as a minimum.

**3.15.4.23 CODE “SRP” RUSTPROOFING PER FED-STD 297E.**

When code SRP is specified, the vehicle shall be rust proofed in accordance with FED-STD 297E

**3.15.4.24 CODE “CPT” PAINT-CUSTOM COLOR.**

This option must be specified when ordering paint colors other than the standard white. The required color(s) must be stated.

**3.15.4.25 CODE “UCT” UNDERCOATING.**

When code UCT is specified, the vehicle shall be undercoated be undercoated for sound deadening, corrosion, and stone damage protection. A commercial, sandless, undercoating or other materials providing equivalent protection, shall be applied to the underbody and under chassis sheet metal surfaces to a thickness of 1/16" to 1/8", except to the drive shafts, drain holes, lubrication points, engine/transmission oil pans, fuel tanks, heavy castings, suspension components, heat shields, heat diffusing devices, catalytic converters, and areas 12" or less from the exhaust system(s) as well as other areas specifically excluded by the chassis OEM. These areas shall be kept free of coating material. Chassis frame, underside of engine compartment hood, and underbody surfaces in excess of 1/8" thickness, or that is inaccessible without removing vehicle fuel tank(s) or other major components shall not require undercoating

**3.15.4.26 CODE “K01” ALS CONFIGURATION.**

When K01 is specified, the ALS configuration shall be furnished. It Includes:

- a. Locked drug compartment.
- b. High intensity cot light.
- c. Two (2) Extra IV hangers
- d. CPR Side Seat w/ occupant restraint device

**3.15.4.27 CODE “K12” AUXILIARY AIR CONDITIONING CONDENSER.**

When K12 is specified, an auxiliary condenser shall be provided which will allow for maximum system performance, based on the air conditioning and FSAM's recommendations. If the condenser is located above the cab, it shall not block the emergency lights. All added refrigeration lines and fittings shall be mechanical fittings compatible with OEM components furnished by the OEM.



#### **3.15.4.28 CODE “SP” SKID PLATES.**

When code SP is specified, OEM protective plates, or shields, shall be provided when available. The skid plate(s) shall provide protection for at least the transfer case. The skid plates shall be demountable for service of the components they protect. Sufficient openings shall be provided to enable draining of transmission and servicing the underside of the engine.

#### **3.15.4.29 CODE “WR” INCREASED GVWR.**

When code WR is specified, the GVWR shall be increased by the OEM to the maximum level available.

#### **3.15.4.30 CODE “K46” FURNISH “H” O2 CYLINDER IN LIEU OF “M” CYLINDER.**

When code K46 is specified, an “H” O2 Cylinder shall be furnished in lieu of an “M” Cylinder.

#### **3.15.4.31 CODE “DVE2” FURNISH EXTRA INTERIOR HEIGHT.**

When code DVE2 is specified, the patient compartment interior height shall be increased to a minimum of 72".

#### **3.15.4.32 CODE “K15C” REFLECTIVE CHEVRON.**

When code K15C is specified, a minimum of 50% of the rear vertical surfaces of the exterior of the ambulance shall be covered with 4" alternating yellow and red chevron reflective striping sloping downward at an angle of 45° from the center of the vehicle

#### **3.15.4.33 CODE “FFP” COOLANT HEATER – FUEL FIRED.**

When code FFP is specified, a fuel fired coolant heater shall be furnished to assist in heating the patient compartment.

### **3.16 PAINTING, COLOR, AND MARKINGS.**

#### **3.16.1 PREPARATION FOR PAINTING.**

Ambulance body and all attached equipment exterior surfaces, except polished metal parts, shall be thoroughly cleaned, treated, and coated with a firm primer and preservative with rust inhibiting properties, and painted in the finish color as specified. Ferrous metal interior surfaces shall be painted or, when not exposed for painting, shall be treated or coated to resist corrosion. Chassis and chassis frame components shall be preserved and finished in accordance to industry's standard practice.

#### **3.16.2 COLOR, PAINT, AND FINISH.**

The exterior color of the ambulance shall be gloss white in combination with a solid uninterrupted orange stripe and blue lettering and emblems. The stripe should be as close to parallel as possible with the road but a stripe transition angle is acceptable to connect the module beltline stripe with the chassis stripe. The exterior finish on painted metal modular bodies and metal roofs on Type II ambulances shall be an acrylic composition urethane or polyurethane paint. The FSAM's painted components shall have a paint film not less than 1.8 mils thick and a minimum total thickness of 2.6 mils including primers. The orange stripe shall not be less than 6" wide, nor more than 14" wide and shall encircle the entire ambulance body at the belt line below the bottom edge of cab windows but may exclude the front of the hood panel. The orange stripe shall be reflective tape. This single, solid band (except when interrupted by windows, locks, etc.), when viewed horizontally, shall appear as a stripe near parallel to the road. The interior finish shall be the FSAM's standard light color harmonizing with the color of upholstery. After application of the final film of paint, the surfaces shall be smooth and uniform.

### **3.16.2.1 COLOR STANDARDS AND TOLERANCES.**

The exterior surface including the wheels shall be FSAM's standard gloss white.

### **3.16.3 SALT SPRAY RESISTANCE.**

Treated exterior sheet metal of the ambulance body (except OEM Type II van) shall be capable of withstanding 250 hours of salt spray tested in accordance with ASTM B 117. The specimen used for the salt spray test shall be run through all steps of the cleaning and treating process, including priming. The primed specimen shall be scored from corner to corner using a sharp knife. After the test, the specimen panels shall exhibit no failure and not more than 1/8" rust or blister creepage from the scored lines.

### **3.16.4 REFLECTIVE EMBLEMS AND MARKINGS.**

The material for the emblems and markings shall be applied using reflective material that has a coefficient of retroreflection measured in accordance with ASTM E 810 of 100 for White and 10 for Blue using 4° entrance angle and a 0.2° observation angle. The reflective color used shall be blue (color a) and white (color i) when applicable. The orange and blue markings shall be as specified Orange and Blue in American National Standard Z535.1, Safety Color Code. They shall comply with the tolerances expressed in terms of Munsell hue, value (lightness), and chroma (saturation). The emblems and markings shall be of the type, size, color, and location as follows:

#### **A. Front markings**

1. The word "AMBULANCE," mirror imaged, shall be in block, blue, die cut style letters, not less than 4" high, centered above the grille, on the orange or white background. The placement of the word ambulance on the curved surface of the hood or on a flat plastic type bugscreen is permitted.
2. A "Star of Life" in 3", blue, die cut style, with a white border; shall be located both to the right and left of the word "AMBULANCE."

#### **B. Side and rear markings**

1. The word "AMBULANCE" shall be in block, blue, die cut style letters of not less than 6" in height, centered, with a white border, alongside or under the "Star of Life" on each side and rear of the vehicle body.
2. A "Star of Life," not less than 16", in blue, die cut style, with a white border, on the right and left side panels. A "Star of Life" emblem, shall be provided on each rear door.

#### **C. Top markings**

A "Star of Life," of not less than 32" in blue, die cut style (may be without the white Staff of Aesculapius), shall be provided on the ambulance rooftop.

### **3.17 MARKINGS, AND CAUTION AND IDENTIFICATION PLATES.**

FSAM's caution plates and identification plates shall be conspicuously installed for all equipment, etc., furnished requiring such notices. The FSAM's "Star of Life" certification shall be provided on a placard or label permanently affixed and easily visible.

Other than the manufacturer's trademark(s) names, no other identification than that specified shall be shown on exterior of the vehicle.

### **3.18 MANUALS, AND HANDBOOK OF INSTRUCTION.**

The FSAM shall furnish with each ambulance one copy of a handbook of instruction in electronic media. This handbook shall contain all information and safety precautions to insure that the operator of the ambulance can properly operate and perform required operator level maintenance specific to the ambulance purchased. As a minimum, this handbook of instruction shall contain.

1. Table of contents
2. Copy of FSAM's invoice showing date of delivery and conditions of sale
3. FSAM's "Star of Life" certification of compliance statement
4. Copy of the FSAM's predelivery Inspection/test form signed by FSAM's inspector
5. Copy of FSAM's final (as built) work order.
6. Shipping papers.
7. List of the FSAM's service points
8. FSAM's components and equipment information (hardware, fixture, etc.) including part numbers specific to the ambulance purchased
9. Complete wiring diagrams and schematics for wiring added to the OEM chassis by the FSAM
10. OEM's operator manual (may be in printed form if electronic form is not available from OEM)
11. Equipment manufacturer's operator manual(s) for any equipment furnished with, or as a part of the ambulance (may be in printed form if electronic form is not available from OEM)
12. All warranty information
13. Weight documents from a certified scale showing actual loading on the front axle, rear axle, and overall ambulance at curb weight
14. Payload Calculation Form
15. Certification of successful completion of the tests in AMD stds 5, 9, 10, 15, 21 & 25 by the FSAM for the ambulance listed in the FSAM's as built work order

If complete parts and service manuals are required for the ambulance, option PSM or PSME must be ordered.

### **3.19 PREDELIVERY INSPECTION AND SERVICING.**

The FSAM prior to the acceptance and inspection of the ambulance(s) shall service and inspect each vehicle in accordance with the OEM's approved predelivery form, and the FSAM's predelivery (test, inspection, and road test) form. A signed copy of these forms (check sheets) shall be furnished with the vehicle. Servicing shall comply with ambient temperatures and conditions applicable with the route of transport to the consignee's ultimate destination. Servicing shall include all tank(s) full of fuel; checking to determine satisfactory and complete operation of all mechanical and electrical features, equipment and system; elimination of rattles, noises, and squeaks; cleaning the interior and exterior. Thus the vehicle shall be delivered ready to use.

### **3.20 WORKMANSHIP.**

1. Vehicles shall be free from defects that may impair their serviceability or detract from appearance.
2. All bodies, systems, equipment, and interfaces with the chassis shall be done in accordance with the OEM Body Builders Book.
3. Defective components shall not be furnished. Parts, equipment, and assemblies that have been repaired or modified to overcome deficiencies shall not be furnished without the approval of the purchaser. Component parts and units shall be manufactured to definite standard dimensions with proper fits, clearances, and uniformity. General appearance of the vehicle shall not show any evidence of poor workmanship.
4. The following shall be reason for rejection:
  - a) Rough, sharp, or unfinished edges, burrs, seams, corners, and joints.
  - b) Grit, seeds, orange peel, fish eyes, streaks, running, sagging, wrinkles, pin holes, craters in paint, failure to meet minimum thickness requirements and non uniformity of specified color.
  - c) Body panels or components that are uneven, unsealed, or contain cracks and dents.
  - d) Misalignment of body fasteners, glass, viewing panels, light housings, other items with large or uneven gaps, spacing, etc., such as door, body panels, and hinged panels.
  - e) Improperly fabricated and routed wiring or harness.
  - f) Improperly supported or secured hoses, wires, wiring harnesses, mechanical controls, etc.
  - g) Interference of chassis components, body parts, doors, etc.
  - h) Leaks of any gas, vacuum, or fluid lines (air conditioning, coolant, oil, etc.).
  - i) Noise, panel vibrations, etc.
  - j) Inappropriate or incorrect use of hardware, fasteners, components, or methods of construction.
  - k) Incomplete or improper welding, riveting, or bolting.
  - l) Lack of uniformity and symmetry where applicable.

# 4. QUALITY ASSURANCE PROVISIONS

## 4.1 RESPONSIBILITY FOR INSPECTION AND TESTS.

The FSAM is responsible for the performance of all inspections and test requirements specified. The FSAM may use their own or any other facilities suitable for the predelivery and acceptance inspections unless disapproved by the purchaser. The purchaser reserves the right to perform any of the inspections and tests set forth in the specification where such inspections are deemed necessary to assure supplies and service conform to the specification and contract. The FSAM shall provide the purchaser's inspection representatives with the FSAM's readily available instruments and all such assistance as they may find necessary.

### 4.1.1 PURCHASER VERIFICATION.

Quality assurance operations performed by the FSAM will be subject to purchaser verification at unscheduled intervals. Verification will consist of observation of the operations to determine that practices, methods, and procedures of the FSAM's inspection are being properly applied. Failure of the FSAM to promptly correct observed deficiencies shall be cause for suspension of acceptance of the ambulance(s) until conformance to specification criteria has been demonstrated.

## 4.2 INSPECTION FOR ACCEPTANCE.

### 4.2.1 QUALITY CONFORMANCE INSPECTION.

Quality conformance inspection applies to all ambulance(s) offered for acceptance under the contract. Quality conformance inspection shall consist of:

1. Workmanship inspection
2. Operational checks
3. Examination of the ambulance handbook
4. Verification of successful completion of AMD tests 001-025

### 4.2.2 OPERATION CHECKS.

Operational checks of the ambulance shall cover all controls, electrical systems, and devices, doors, windows, cabinets, accessories, in and outside the ambulance. Ambulance shall be driven at highway speeds, turns made at minimum radii, brakes tested for dependability, checked for rattles and squeaks. All controls and mechanisms shall function and operate as intended at the time of delivery.

### 4.2.3 INSPECTION FAILURE OF AMBULANCE (S).

Failure of a production ambulance to have the certifications required or successfully complete the examinations and tests shall be cause for non-acceptance of any of the contract quantity, until deficiencies are corrected and evidence of the corrective action preclude recurrence of similar deficiencies. Failure of the ambulance to successfully complete inspection shall not constitute an excusable delay in meeting scheduled deliveries.

## **4.3 “STAR OF LIFE” CERTIFICATION REQUIREMENTS.**

### **4.3.1 QUALIFYING PROVISIONS.**

The FSAM is obligated to certify to the Government/ purchasers that the ambulance bearing the “Star of Life,” its components, and equipment meet or exceed all the requirements and tests set forth in this specification. The certification and “Star of Life” label, verify that the ambulance conforms to the version of this specification in effect on the date the ambulance was contracted for. Compliance for a “Star of Life” label is defined as certification backed by confirmed verifications of inspections and tests. The verifications shall be in possession of the issuer and presented if and when challenged. For the benefit of purchaser's procuring activity evaluation and review, prior to or with each proposed bid (solicitation), the FSAM shall provide and forward representative material of their “Star of Life” ambulance(s). This material shall include: a letter certified by a company officer, stating that the delivered ambulance(s) shall comply with paragraphs 4.3.2 thru 4.3.5. Failure to provide certification, at the time the vehicle is presented for inspection, will deem the vehicle unacceptable and shall constitute grounds for termination in accordance with the terms of the contract. Also included shall be: general specification data, exterior and interior pictures, dimensional drawings/data, etc., and other information as requested.

### **4.3.2 DOCUMENTATION OF “STAR OF LIFE” CERTIFICATION.**

The FSAM shall compile complete certified documentation of verifications for all the tests required under 4.4 conforming to 4.3.3 and 4.3.5 for each Type of ambulance intended to be marketed to the Emergency Medical Care industry as a “Star of Life” ambulance.

### **4.3.3 CRITERIA OF CERTIFICATIONS.**

The initial testing and inspections required for certification shall be performed by a nationally recognized independent testing facility. The individual certifications will remain valid for five years as long as the type of ambulance tested remains in production. Design changes during the five year certification period must be tested at the time of production release.

Certifications that appear on the ambulance need not be re-submitted (i.e.; DOT, EPA, etc.). Certification(s) will be acceptable in lieu of actual verification test during inspections providing supporting verifying data complying with 4.3.3 is on file for examination.

Certification from OEM and individual equipment manufacturers are acceptable providing they are not part of a system(s) or altered and in accordance with 4.3.4.

Type certifications of individual components and equipment products are acceptable.

Each ambulance constructed shall be tested by the FSAM to demonstrate compliance with AMD Standards 5, 9, 10, 15, 21 & 25. This is in addition to the initial type testing certification required.

#### **4.3.4 CERTIFICATION LETTER FORMAT.**

Certification letters submitted for the ambulance model, components, and equipment being certified shall contain the following information on FSAM's letterhead stationery in electronic format (pdf files):

1. To whom certifying.
2. Date.
3. Units or items.
4. FSAM and address.
5. Date product tested.
6. Model number and specification data.
7. Applicable specification references and test requirement.
8. Summary of the test report.
9. A certifying statement w/ official signature.

#### **4.3.5 CERTIFICATION VERIFICATION DATA REPORTS.**

The testing facility for each certification shall supply supportive verification data and information on letterhead stationery in electronic format (pdf files):

1. For whom tested.
2. Report date.
3. Name of sample product or device.
4. FSAM's address.
5. Serial and model number(s).
6. Specification referral and amendment number(s), and test requirement(s).
7. Test facilities used and location.
8. Test equipment used.
9. Test procedure.
10. Test results.
11. Verifying test data.
12. Photographs.
13. Test conclusion(s).
14. Witness(es), and authorized signature.

### **4.4 TESTS.**

#### **4.4.1 TEST CRITERIA.**

The ambulance shall be prepared for operation in accordance with OEM's recommendations, and AMD Standards 001-025. The ambulance shall successfully complete all parts of the quality conformance inspection.

# 5. DELIVERY

## 5.1 PREPARATION FOR DELIVERY.

The ambulance(s) shall be preserved and packaged for mobile delivery in accordance with the FSAM's standard commercial practice, insuring carrier acceptance and safe delivery to destination in compliance with regulations applicable to the mode of transportation.

## 5.2 GOVERNMENT/PURCHASER RESPONSIBILITY.

The FSAM shall deliver the vehicle to the consignee delivery address designated on the motor vehicle delivery/purchase order.

The Government/Purchaser is responsible for:

1. Notifying the FSAM of the delayed delivery date and the in-transit mileage accumulation as applicable.
2. In the presence of the delivering driver, immediately inspecting the vehicle for damage, abuse, loss or theft that may have occurred during transit. Any such findings should be accurately described on the delivery receipt the driver presents for signature. If the vehicle(s) are covered with snow, ice or dirt so as to prevent a complete inspection at the time of delivery, this is to be noted on the delivery receipt. The driver is required to acknowledge any notification on the delivery receipt by signature.
3. Notifying the FSAM of any damages or shortages found within 24 hours.
4. Obtaining local safety and emission testing that may be required.
5. Obtaining the title and license plates that may be required.
6. Retuning the warranty registration card(s) to the FSAM. The FSAM's warranty does not go in effect until the ambulance is registered with the FSAM by the Government/Purchaser.



# 6. NOTES

## **6.1 INTENDED USE OF SPECIFICATION.**

The intended use of this specification is to define and procure certified “Star of Life” ambulances for use by the federal government. The use of this specification by State and local Governments is permitted.

Since the use of this specification is voluntary for State Governments, each State Department of Health will generally determine if their state wishes to use this specification.

### **6.1.1 FEDERAL SPECIFICATION COVERAGE.**

This federal specification covers only the ambulances approved to display the “Star of Life” symbols for use by the federal, state and local governments of the United States.

### **6.1.2 PRECAUTIONS AND OBSERVATIONS.**

Purchasers should read the entire document before requisitioning an ambulance, in order to be knowledgeable of just what equipment is standard, and which options need to be exercised. Due to the variety of ambulance equipment or features, some options may be incompatible with the model desired (reference OEM and FSAM's data books).

### **6.1.3 DEFINITION OF GOVERNMENT-PURCHASER.**

Government or purchaser as used in the context of this document means the federal, state, or local government.

## **6.2 WARRANTY.**

### **6.2.1 WARRANTY COVERAGE.**

The FSAM shall warrant the ambulance and furnished equipment against parts failure or malfunction due to design, construction, or installation errors, defective workmanship, and missing or incorrect parts for a minimum period of 12 months or 12,000 miles (which ever occurs first) for domestic use, and 15 months or 12,000 miles (which ever occurs first) for foreign use from date of acceptance\*, exclusive of any authorized accumulated driveway mileage.

However, if the FSAM received from any supplier or subcontractor additional warranty on the whole or any component of the ambulance, in the form of time and/or mileage, including any prorate arrangements, or the FSAM generally extends to their commercial customers a greater or extended warranty coverage, the Government/purchaser shall receive corresponding warranty benefits.

\*The warranty begins when the Government/purchaser accepts the ambulance from the FSAM FOB point of destination.

#### **6.2.1.1 DOMESTIC USE.**

When vehicles are used within the 50 States of the United States, the District of Columbia, the Commonwealth of Puerto Rico, American Samoa, Guam, the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific islands, and the Virgin Islands, the warranty shall include furnishing, without cost to the Government (FOB FSAM's nearest dealer or branch to vehicle's location or station), new parts and assemblies to replace any that failed or malfunctioned within the warranty period. In addition, when the Government elects to have the work performed at the FSAM's plant, branch, or dealer, or with the FSAM's approval (i) to correct the vehicle itself or (ii) to have the vehicle corrected by a commercial garage facility, the cost of the labor involved in the replacement of the failed or malfunctioned parts or assemblies shall be borne by the FSAM.

#### **6.2.1.2 FOREIGN USE.**

When vehicles are used outside the 50 States of the United States, the District of Columbia, the Commonwealth of Puerto Rico, American Samoa, Guam, the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific islands and the Virgin Islands, the warranty shall include the furnishing of new parts or assemblies to replace any returned to the FSAM by the Government which failed or malfunctioned within the warranty period. The replacement parts or assemblies shall be delivered by the FSAM to the port of embarkation in the United States designated by the Government. The FSAM shall not be required to bear the cost of the labor involved in correcting defects in vehicles operated in foreign countries.

#### **6.2.2 WARRANTY EXCLUSIONS: OEM PROVISIONS APPLY.**

The following items are considered normal maintenance and repair for which the FSAM need not assume liability for reimbursing the Government/purchaser regardless of the ambulance age or mileage:

1. Abuse, negligence, or un-approved alteration of original parts.
2. Damage from accidents.
3. Standard brake and clutch adjustments.
4. General tightening, headlamp adjustments.
5. Wheel alignment or tire balancing.
6. Tires, batteries, medical supplies and equipment, and radio(s) (if warranted by their manufacturers.
7. Miscellaneous expense such as fuel, towing, telephone, travel, lodging, or loss of personal property.

### **6.3 REPAIR PARTS AND SERVICE.**

As continuous operation of the ambulance described by this specification is of utmost importance for the successful FSAM to be in a position to render prompt service and to furnish replacement parts. Accordingly, FSAMs shall indicate the extent of their ability to render prompt service by furnishing a list of branch offices or agencies where complete stocks of repair parts are maintained and can be secured within a reasonable time after ordering by part number from the FSAM's part book and at such discount as may be quoted from year to year by the FSAM purchased under this specification.

## **6.4 STATEMENT OF ORIGIN OR BILL OF SALE.**

A FSAM's Statement of Origin or Bill of Sale showing the applicable purchase order number is required for each ambulance procured under this specification. Such documents shall be forwarded to the consignee's mailing address.

## **6.5 CHANGES AND AMENDMENTS.**

When a using agency or purchaser considers that this specification requires revision, a written request for change or additions to the document supported by adequate justification should be filed on the General Services Administration, Automotive Center, Engineering Branch (QMDAA)'s electronic comment collector. The agency will be informed of action taken. New and revised information regarding this specification may be issued from time to time under an amendment to the federal specification. These amendments are identified by the same number and title as the document. Amendments should be retained until such time as the entire document is revised.

### **Custodian & Preparing Activity:**

GSA-FAS-QMDAA

# FIGURE 1

## Certification & Payload Signage

The label shall be mounted on the body (module) interior in a conspicuous location.

- The label shown here is suggested format.
- Deviations in dimensions are acceptable.
- All text must be included.

### **CERTIFIED "STAR OF LIFE" AMBULANCE**

Date of Manufacture \_\_\_\_\_

Mfg By \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

This ambulance conforms to Federal Specification KKK-A-1822 in effect on the date the ambulance was contracted for.

Final Stage Ambulance Manufacturers ID Number \_\_\_\_\_

VIN \_\_\_\_\_

OEM Chassis Model, Year of Manufacture \_\_\_\_\_

Vehicle Type \_\_\_\_\_

***NOTICE: THIS VEHICLE, AS MANUFACTURED, CONFORMS TO THE PAYLOAD REQUIREMENTS OF THE FEDERAL AMBULANCE SPECIFICATION KKK-A-1822. USERS SHALL NOT LOAD VEHICLES ABOVE THE GVWR, GAWRs OR EXCEED THE TOTAL USABLE PAYLOAD LISTED BELOW.***

TOTAL USABLE PAYLOAD \_\_\_\_\_lbs.

(TOTAL REMAINING WEIGHT CAPACITY OF OCCUPANTS AND CARGO USER MAY ADD)

# FIGURE 2

## Payload Calculation Form

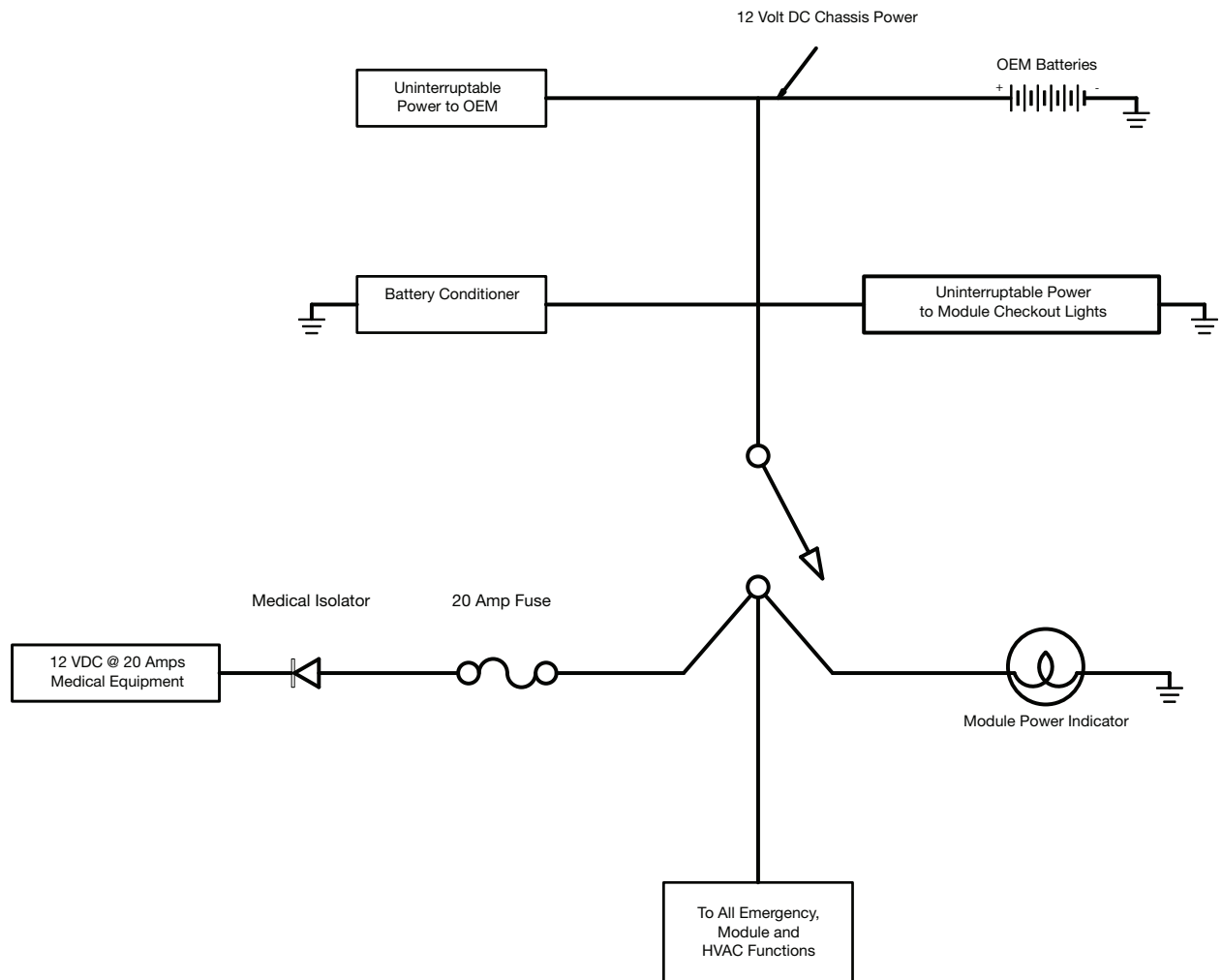
The completed form shall be included in the handbook of instructions.

- The form shown here is suggested format.
- Deviations in dimensions are acceptable.
- All text must be included.

CUSTOMER USABLE PAYLOAD INFORMATION	
Final Stage Ambulance Manufacturer's Name:	_____
OEM Chassis Year, Make, Model:	_____
1) Ambulance Model, Type, Prod. #:	_____
2) OEM GAWR – Front:	_____ lbs
3) OEM GAWR – Rear:	_____ lbs
4) OEM GVWR:	_____ lbs
5) Minimum Payload Per KKK-A-1822:	_____ lbs
6) Curb Weight – <b>AS BUILT</b> – Front Axle:	_____ lbs
7) Curb Weight – <b>AS BUILT</b> – Rear Axle:	_____ lbs
8) Total Curb Weight – <b>AS BUILT</b> :	_____ lbs
9) <b>CUSTOMER USABLE</b> Total Payload <b>AS BUILT</b> (item 4 minus item 8):	_____ lbs
10) <b>CUSTOMER USABLE</b> Front Axle Payload <b>AS BUILT</b> (item 2 minus item 6):	_____ lbs
11) Total Weight of Permanently mounted Options Specified (only required if item 9 does not meet or exceed item 5):	_____ lbs
12) Payload of Basic KKK Vehicle (item 9 plus item 11) (only required if item 9 does not meet or exceed item 5):	_____ lbs

# FIGURE 3

## 12-Volt DC Electrical System



# FIGURE 4

## 125-Volt AC Electrical System

ELCI (Equipment Protection) Provided by Purchaser's Stationary Utility Power.  
30mA Trip Level

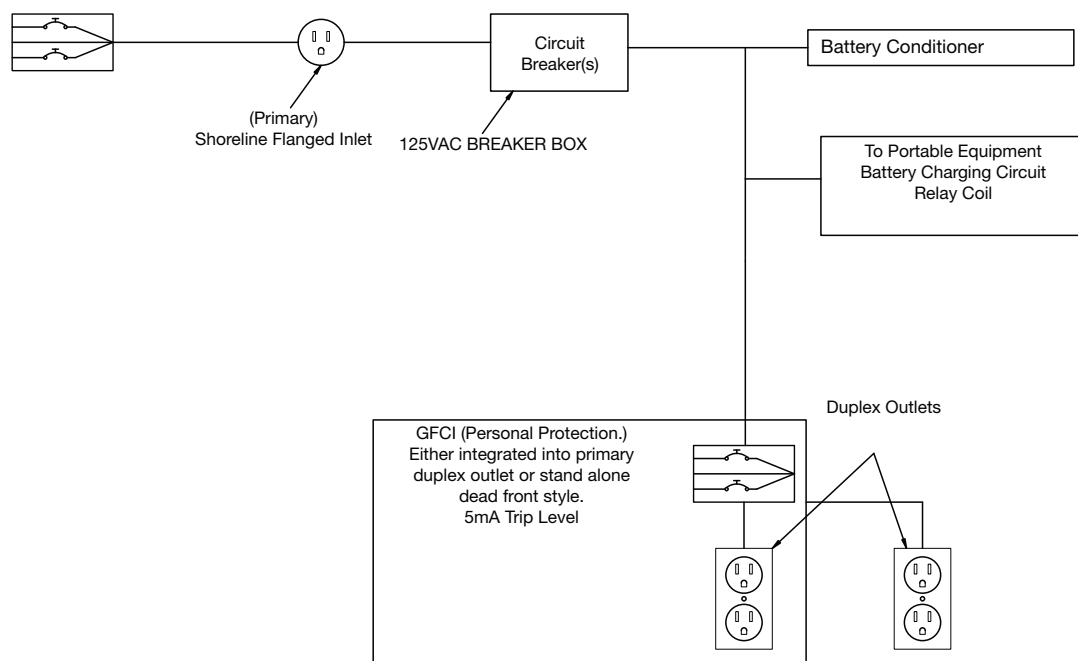
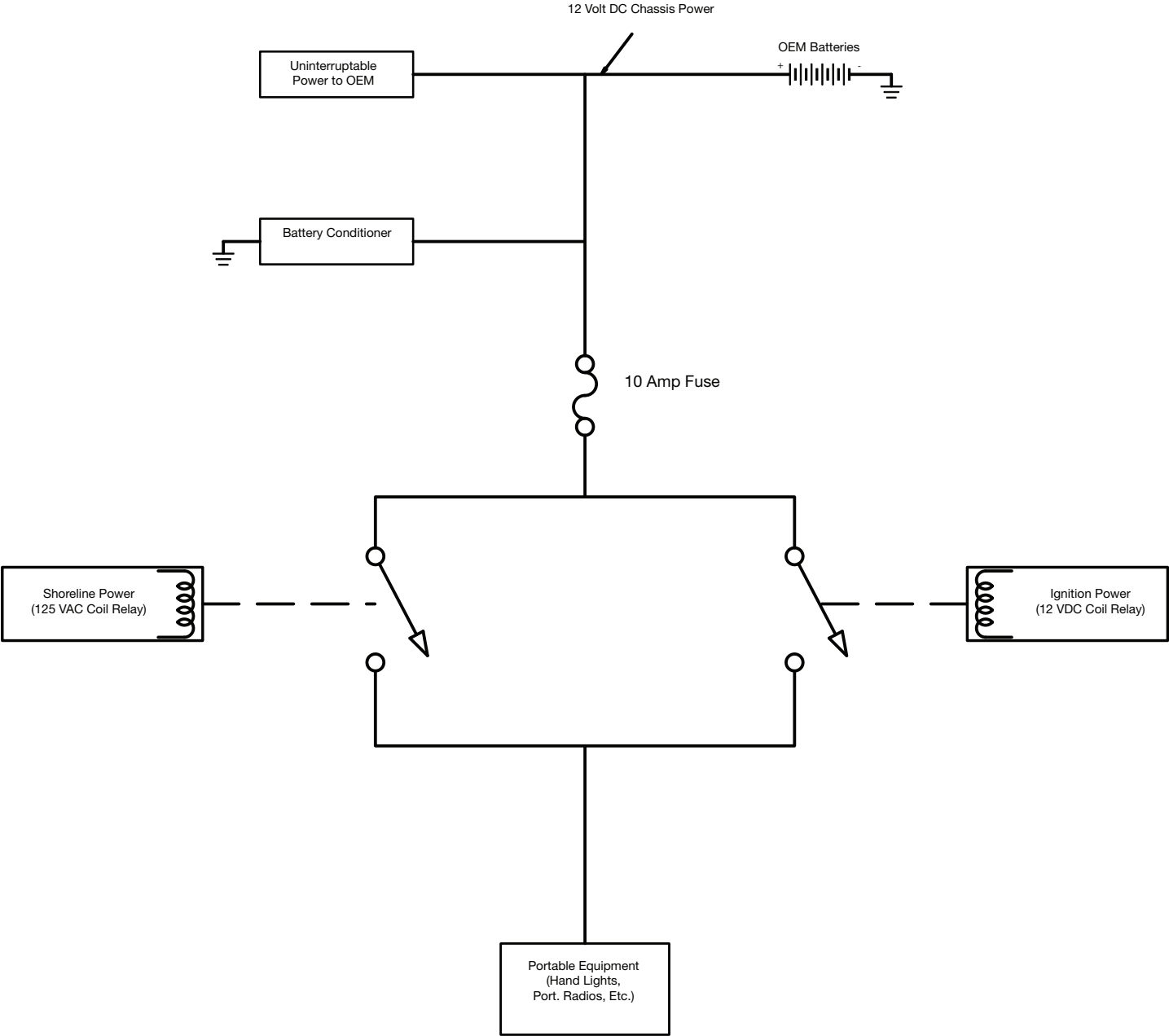


FIGURE 5

Portable Equipment Battery Charging Circuit







*Smarter Solutions*



This document supersedes KKK-A-1822E, dated June 1, 2002

This document may be downloaded at no cost from the Internet at:  
[WWW.GSA.GOV/AUTOMOTIVE](http://WWW.GSA.GOV/AUTOMOTIVE)

Comments, information, and questions should be sent to:  
Chief, Automotive Engineering & Commodity Management Branch (QMDAA)  
Office of Motor Vehicle Management  
General Services Administration  
2200 Crystal Drive, Suite 1006  
Arlington, VA 22202  
Telephone: 703.605.2277



A/R 5-401

**OFFICE OF EMERGENCY MEDICAL SERVICES**  
**Administrative Requirements Manual**

Effective: 6/30/2002 Authorization: Page: 1 of 10  
 A/R Title: Ambulance Equipment List  
 Basic Life Support  
 Supersedes: BLS List Effective March 1, 2000

**General Principles**

- A. **AUTHORIZED EQUIPMENT:** Ambulance services must carry equipment and medications as required by Statewide Treatment Protocols. Ambulance services should not equip ambulances with equipment that is outside of scope of practice of its EMT employees, or outside of the service's level of licensure.
- B. **PERFORMANCE STANDARDS:** All equipment must be designed and constructed to meet medical performance objectives and must not endanger patients.
- C. **MAINTENANCE:** All equipment and supplies must be maintained according to manufacturers' specifications with regard to maintenance, storage, expiration date, replacement, etc.

Item #	Name	Class	Description & Quantity
1	Ambulance Cot	I, II	<ul style="list-style-type: none"> <li>One 4-wheeled, multi-level ambulance cot.</li> <li>Standard cot mattress with waterproof cover.</li> <li>Patient restraining devices at chest (commercial shoulder harness or equal) hip, and knee to prevent lateral or longitudinal displacement of the patient during transport.</li> <li>Dual I.V. holder, capable of being cot mounted.</li> <li>Padded wrist and ankle restraints, minimum one complete set.</li> </ul>
2	Bag Valve Mask Ventilation Unit	All	<p>One (1) hand-operated bag/mask ventilation unit with adult mask(s), capable of use with oxygen supplies (disposable, single use units recommended). Unit must be accessible within the patient compartment, and include, at minimum:</p> <ul style="list-style-type: none"> <li>(a) One (1) each child and infant size bag/mask ventilation units with Appropriate mask(s), capable of use with oxygen supply (disposable, single use units recommended);</li> <li>(b) Two (2) oxygen connector tubes, minimum 84 inches long;</li> <li>(c) One (1) oxygen supply reservoir for each bag/mask ventilation unit.</li> </ul>
3a	Portable Oxygen Unit	All	<p>Portable positive pressure resuscitator/inhalation unit designed to operate in conjunction with external cardiac compressions and deliver nearly 100% oxygen. All components must be stored together. Unit must be equipped with:</p> <ul style="list-style-type: none"> <li>(a) One (1) bag/valve/mask ventilation unit. The Addition of a flow restricted, oxygen powered ventilation device (demand valve) is optional;</li> <li>(b) Oxygen cylinder with minimum capacity of 300 liters;</li> <li>(c) Oxygen cylinder pressure gauge and regulator capable of delivering a range of zero (0) to fifteen (15) liters per minute;</li> </ul>

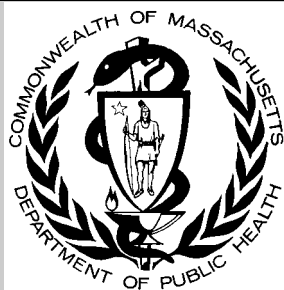


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Item #	Item Name	class	Description and Quantity
3a Cont'd (Port. Oxygen Cont.)			(d) Two (2) different sizes of resuscitator face masks; (e) Two (2) Each child and adult size transparent, disposable, high concentration oxygen masks with delivery tubes. (f) Two (2) adult nasal cannula with delivery tube; (g) Oxygen connecting tubing; (h) Cylinder wrench or wheel secured to unit; One (1) full spare oxygen cylinder, minimum 300 liters. All spare cylinders to be maintained in vehicle, but not part of the kit. All spare cylinders must be stored in a crash stable devices per KKK-A-1822, and any amendments thereto.
3b	Installed Oxygen System	I, II	An installed oxygen system conforming to Applicable sections of the Federal Specification for Ambulances KKK-A-1822, and any amendments thereto, and equipped with the following: (a) Two (2) Flowmeters capable of delivering a range of zero (0) to 15 liters per minute, at minimum; (b) Unbreakable oxygen humidifier, disposable, for single use only; (c) Sterile water for use with oxygen humidifier; (d) Four (4) each adult and child size, transparent, disposable, high concentration oxygen masks with delivery tubes; (d) Four (4) Each adult and child sizes of disposable nasal cannulae with delivery tubes;
4	Installed Suction	I, II	[required by KKK-A-1822 s.3.12.3; but not previously itemized on equipment list] Electrically powered suction aspirator system shall be furnished with an illuminated switch, and panel mounted, to include: (a) One (1) non-breakable, transparent collection bottle or bag, minimum 1,000 ml capacity; (b) One (1) suction rinsing water bottle; (c) Two (2) semi-rigid pharyngeal suction tip with thumb suction control port; (e) Two (2) transparent or translucent, non-kinking suction tubing min. 1/4 inch in diameter; (f) Two (2) Each 5, 8, 14 French suction catheters; and ten (10) spare collection bags when bag type system is furnished.
5	Portable Suction Unit	All	One (1) adjustable gas or battery powered portable suction apparatus, capable of delivering a minimum vacuum of 600 millimeters of mercury and equipped with the following: (a) Wide bore, non-kinking tube;



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Item #	Item Name	class	Description and Quantity
5 Cont'd			(b) Pharyngeal suction tip; (c) Non-breakable, transparent collection bottle, minimum capacity 550 cc (disposable container recommended); (d) One (1) pair disposable exam type gloves; (e) One (1) combination face mask/eye shield or one (1) each facemask and protective eye wear.
6	First Aid Kits	I, II	Two (2) portable first aid kits.
		IV, V	One (1) portable first aid kit.
			Kits may be incorporated into other kits (i.e., portable oxygen kit.) Each first aid kit to be supplied and equipped with the following equipment: (a) Three (3) wrapped oropharyngeal airways, one (1) each, infant, child and adult sizes; (b) Twelve (12) small dressings (sterile gauze pads, minimum size 4"x4"); (c) Four (4) medium dressings, sterile, minimum size 5" x 9"; (d) Two (2) large dressings (sterile universal dressings, minimum size 10"x 3 0") (e) Six (6) rolls soft roller, self-adhering bandage, minimum 4" x 5 yds; (f) Four (4) cravats or triangular bandages, minimum 40" wide; (g) Two (2) arterial tourniquets for control of arterial bleeding, commercial or equivalent; (h) Two rolls 2" adhesive tape, minimum 5 yards; (i) One (1) 7" bandage scissors or equivalent; (j) One (1) adult size sphygmomanometer; (k) One (1) stethoscope; (l) One (1) penlight-type flashlight; (m) One (1) unbreakable container of sterile water or saline solution, minimum one pint (500 cc); (n) One (1) wrapped 3 ounce bulb syringe for irrigation purposes; (o) Two (2) cold packs; (p) One (1) tube glucose based paste or equivalent; (q) Two (2) wrapped tongue depressors for glucose administration; (r) Six (6) band-aids, minimum 3/4"; (s) One (1) mouth-to-mouth resuscitator mask with one way valve and an oxygen port (disposable type recommended); (t) Two (2) combination face mask/eye shield or two (2) each facemask and protective eye wear; (u) Two (2) pair disposable exam type gloves.
7	Traction Splints	I, II	<ul style="list-style-type: none"> <li>One (1) hinged Thomas-type half ring lower extremity splint or equivalent;</li> <li>One (1) child-sized hinged Thomas-type half ring lower extremity type with ankle hitch and leg ties or equivalent, with ankle hitch and leg ties. All accessory items to be stored with splints.</li> </ul>

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Item #	Item Name	Class	Description and Quantity
8	Padded Board Splints	All	Covered padded board splints or equivalent impervious to saturation by fluids, minimum two (2) each of the following sizes: (a) 3 feet by 3 inches; (b) 15" inches by 3 inches; (c) 4 1/2 feet by 3 inches.
9	Spine Boards and Accessories	All	<ul style="list-style-type: none"> <li>One (1) half spine board meeting AAOS standards, with three (3) torso straps and head strap (2" tape or functional equivalent), or equivalent (i.e., KED);</li> <li>One (1) full spine board meeting AAOS standards;</li> <li>Accessories for each full spine board carried, stored together, as follows:              (a) Four (4) straps of 9 foot length or functional equivalent;              (b) Four (4) adult rigid cervical collars of various sizes (e.g. no-neck, small, medium, and large), or one (1) adult adjustable collar, and three (3) child size rigid cervical collars of various sizes (e.g. infant, toddler, and child), or one pediatric adjustable collar, at a minimum;              (c) Sufficient padding material to maintain in-line head and cervical spine support and stabilization (i.e., foam blocks, rolled blankets, and/or towels).</li> </ul>
10	Stair Chair	I, II	One (1) stair chair with patient restraint straps
11	Auxiliary Stretcher	I, II	One (1) auxiliary stretcher with patient restraint straps, or equivalent (i.e., orthopedic "scoop" stretcher, "Reeves" type stretcher, long spine board)
12	Transfer Sheet	I, II	One (1) transfer sheet with a minimum of six (6) handles, or equivalent.
13	Airways	I, II	Six (6) Wrapped oropharyngeal airways (2) Each infant, child, and adult [in addition to those listed in the first aid kit]; (a) Eight (8) adult size nasal airways, one (1) each 20F, 22F, 24F, 26F, 28F, 30F, 32F, and 34F; (c) Four pediatric nasal airways, One (1) Each 12F, 14F, 16F, 18F; (d) One disposable package water soluble lubricant per nasal airway.
Revised 12/00			
14	Small Dressings	I, II	Twenty-four (24) sterile gauze pads, minimum 4" x 4".
15	Medium Dressings	I, II	Twelve (12) sterile, individually packaged dressings, minimum 5" x 9", or equivalent (i.e., sterile sanitary napkins)



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Item #	Item Name	class	Description and Quantity
16	Large Dressings	I, II	Six (6) sterile, individually wrapped universal dressing, Minimum 10" x 30".
17	Soft Roller Bandage	I, II	Twelve (12) rolls soft roller, self-adhering bandage, either 3" or 4" size.
18	Triangular Bandage	I, II	Twelve (12) triangular, commercial or equivalent, of unbleached muslin, minimum 40" wide.
19	Adhesive Tape	I, II	Four (4) rolls of 1"x 5yd, one of which must be hypoallergenic.
20	Bandage Shears	I, II	One (1) pair bandage shears.
21	Burn Sheets	All	Two (2) sanitary, wrapped burn sheets, linen or disposable.
22	Obstetrical Kit	All	One (1) sterile commercial obstetrical kit; OR One (1) sterile obstetrical kit containing the following: (a) One (1) large towel; (b) One (1) receiving blanket, or equivalent; (c) One (1) pair sterile disposable plastic or rubber gloves; (d) Six (6) sterile gauze pads, minimum 3" x 3"; (e) Two (2) Kelly clamps or sterile ties; (f) Six (6) sanitary napkins; (g) One (1) infant bulb syringe; (h) One (1) pair scissors (bandage or surgical blade); (h) One (1) container with lid for carrying placenta; (i) One (1) newborn swaddler system, i.e. space blanket, foil swadler, or equivalent to retain body temperature.
23	Poison Antidote Kit	All	One (1) poison antidote kit, containing: (a) Activated charcoal; Measuring device.
24	Irrigation Fluid	I, II	Three (3) liters of sterile water or saline solution, in unbreakable containers, in a minimum of three (3) containers.
25	Aluminum Foil	I, II	One (1) roll of aluminum foil, minimum 12 inches by 25 feet, or adult size space blanket.
26	Polyethylene Film	I, II	One (1) roll of polyethylene film.



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Item #	Item Name	class	Description and Quantity
27	Bed Pan	I, II,	One (1) adult bed pan.
28	Motion Sickness	I, II, IV	Two (2) motion sickness bags, or equivalent , capable of being sealed.
29	Pillows	I, II IV, V	Two (2) pillows with waterproof plastic covers, and four (4) pillow cases. One (1) pillow with waterproof plastic cover, and two (2) pillow cases.
30	Sheets	I, II IV, V	Eight (8) sheets, disposable or linen; Two (2) sheets, disposable or linen.
31	Blankets	I, II IV, V	Four (4) blankets. Two (2) blankets.
32	Towels	I, II	Four (4) towels.
33	Tissues	I, II	Two (2) packages of disposable paper tissues.
34	Drinking Cups	All	Two (2) or more disposable drinking cups.
35	Cold Packs	I, II	Four (4) cold packs
36	Glucose	I,II	Two (2) glucose based paste or equivalent, and wrapped tongue depressors for glucose administration. ( <i>other than what is in first aid kits.</i> )
37	Infection Control Kit	All	One (1) infection control kit, containing two (2) each of disposable, fluid resistant gowns, masks, caps, protective eye wear, and two (2) different sizes of gloves.
38	Ring Cutter	I, II,	One (1) ring cutter.

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**OFFICE OF EMERGENCY MEDICAL SERVICES**  
**Administrative Requirements Manual**



Effective: 6/30/2002 Authorization: Page: 7 of 10  
 A/R Title: Ambulance Equipment List  
 Basic Life Support  
 Supersedes: BLS List Effective March 1, 2000

Item #	Item Name	class	Description and Quantity
39	Adult Sphygmomanometer	I	One (1) adult, sphygmomanometer.
40	Large Adult	All	One (1) large adult, or thigh size sphygmomanometer.
41	Child Size Sphygmomanometer	I, II, V	One (1) child size sphygmomanometer.
42	Infant Sphygmomanometer	All	One (1) infant size sphygmomanometer.
43	Stethoscope		One (1) stethoscope to be a component of patient compartment stocks. (other than what is in first aid kits.)
44	Plastic Bags	I, II	Two (2) large plastic bags with ties.
45	Contaminated Trash Container	All	Two (2) disposable "Bio-Hazard" bags, with ties.
47	Eye Shields	I, II	Two (2) combination face mask/eye shield or two (2) each face mask and protective eye wear.
48	Gloves	I, II	Six (6) pairs of disposable exam type gloves in three (3) different sizes.
49	Hand Cleaner	I, II, V	One (1) dispenser antiseptic hand cleaner, or 25 individually wrapped antiseptic hand wipes.
50	Latex-free Equipment	ALL	One (1) commercial latex-free kit; OR one (1) labeled latex-free kit containing the following: (a) latex-free examination gloves, two (2) pairs each, small, medium and large; (b) latex-free tourniquet; (c) latex-free adult BVM and masks; (d) latex free high concentration, disposable, oxygen masks with delivery tubes, two (2) each, adult and child; (e) latex-free nasal cannulae and delivery tubes, two (2) each, adult and child; (f) latex-free B/P cuff; and (g) latex-free stethoscope.

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51 CPR Board	I,II	CPR board or functionally equivalent (i.e., short board) hard surface for patient torso accessible to patient compartment.
52 Automatic Defibrillator	I,II,V	One Automatic external cardiac defibrillator (AED) appropriate to ambulance staffing configuration, with appropriate accessories. Effective date: March 1, 2002
53 Epi-Pens	ALL	Two (2) each, child and adult Epi-Pens. Effective June 30, 2002
54 Aspirin	ALL	30 tablets of chewable pediatric-strength (81 mg/tablet) aspirin, or 30 tablets of adult-strength (162-325 mg/tablet) aspirin. Effective June 30, 2002



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**EQUIPMENT TO GAIN ACCESS**

Item #	Item name	class	Description and Quantity
1	Equipment to Gain Access	I,II	(a) One (1) screwdriver, minimum 8" regular blade (b) One (1) hacksaw with six (6) wire (carbide) blades (c) One (1) pair of pliers, 10" vice grip (d) One (1) short handled sledge hammer, minimum 3 pounds (e) One (1) rope, synthetic, minimum 50 feet by 1/2 inch diameter or functional equivalent (f) Two (2) pairs of gloves (leather gauntlets) (g) Two (2) pairs of goggles (clear eye protective)



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**VEHICLE EQUIPMENT**

Item #	Item name	Class	Description and Quantity
1	Warning Lights	V	Emergency warning beacon, visible 360 degrees, as permitted by M.G.L. c.90, s.7, or as required under KKK-A-1822 and any amendments thereto.
2	Audible Warning Devices	V	A siren, audible 500 feet to the front.
3	Maps	I, II, V	Street directories and road maps for primary and backup areas served.
4	Fire Extinguishers	I, II	Two (2) adequately charged fire extinguishers, five (5) pound CO2 or dry powder, Underwriter's Laboratory approved, one of which shall be mounted in the patient compartment.
		V	One (1) adequately charged fire extinguisher, five (5) pound CO2 or dry powder, Underwriter's Laboratory approved.
5	Handlights	I, II, V	Two (2) 6-volt handlights, bulb type, or two bulb type handlights with rechargeable battery of 4.5 volts minimum.
6	Chock Blocks	I, II	Two (2) vehicle chock block.
7	Road reflectors	I, II, V	Six (6) DOT approved triangular reflectors, or equivalent.
8	Hazardous Material Guidebooks	I, II, V	<ul style="list-style-type: none"> <li>One (1) U.S. Department of Transportation Emergency Response Guidebook, current edition;</li> <li>One (1) National Institute of Occupational Health and Safety (NIOSH) Pocket Guide to Chemical Hazards, current edition.</li> </ul>
9	Binoculars	I, II, V	One (1) pair of binoculars minimum 7x35 mm.
10	Triage Tags	I, II, V	Twenty five (25) triage tags.
11	Protective Equipment	I, II, V	Personal protective equipment adequate to safeguard crew from anticipated exposures as defined by the licensee.
12	Reflective Garment	All	One (1) set reflective vest or reflective garment, or equivalent, per crew member.
13	Protective Masks	All	Two (2) respirators, conforming to OSHA Bloodborne Pathogens Standard 29 CFR 1910.1030 (HEPA ).

# Ambulance Reliability Control

Worcester Polytechnic Institute  
Worcester, Massachusetts  
March 19th, 2008

## Project Members

Samuel Allen  
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## Project Advisor

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## Overview

- ▣ Foundational Thinking
- ▣ Mission
- ▣ Functional Objectives
- ▣ New Ambulance Design
- ▣ Comparison
- ▣ Conclusion

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## Foundational Thinking

- ▣ Limited design modifications.
- ▣ Limited technological advances in ambulances.
- ▣ Use of modern materials limited.
- ▣ Safety.
- ▣ High cost.

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## Mission

- ▣ To build and advance a medical ambulance that will enrich the following:
    - Storage capacity and accessibility
    - Temperature regulation and vibration damping
    - Weight reduction and vehicle stability
    - Informative communication and data transfer
    - Waste management and sanitation
    - Safety and EMT mobility
    - Treatment and drug delivery
    - Tele-ambulance
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## Functional Objectives

- ▣ Increase storage capacity.
  - ▣ Improve storage layout.
  - ▣ Reduce the weight of the ambulance.
  - ▣ Reduce manufacturing cost.
  - ▣ Establish working relationship between WPI and UMass Memorial Hospital
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## Comparison

- ▣ Use of composite materials.
    - Reduce overall weight.
    - Decrease manufacturing costs.
  - ▣ Single-point access to many stored materials.
    - Less time wasted searching cluttered cabinets.
    - EMT remains buckled in, improves safety.
  - ▣ External storage configuration
    - Increases useable volume in patient compartment.
    - Externally stored items closer to ground level.
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## Conclusion

- ▣ This ambulance design concept effectively reduces overall weight and increases ease-of-use through the incorporation of a number of useful technologies.
  - ▣ We believe that the design will offer a superior ambulance at a comparable price to many of the designs that are currently on the market.
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